



Environment

Submitted to:
BNSF Railway Company
800 N. Last Chance Gulch, St. 101
Helena, Montana 59601

Submitted by:
AECOM
Billings, Montana
60285818-400
July 2014 – Rev. 1

Human Health Risk Assessment Amendment – Revised Draft

BNSF Mission Wye Livingston, Montana



Environment

Submitted to:
BNSF Railway Company
800 N. Last Chance Gulch, St. 101
Helena, Montana 59601

Submitted by:
AECOM
Billings, Montana
60285818-400
July 2014 – Rev. 1

Human Health Risk Assessment Amendment – Revised Draft

BNSF Mission Wye Livingston, Montana

A handwritten signature in blue ink, reading 'Christine Casaceli Johnson', written over a horizontal line.

Prepared By
Christine Casaceli Johnson, Human Health Risk Assessor

A handwritten signature in blue ink, reading 'Shelly Young', written over a horizontal line.

Reviewed By
Shelly Young, Project Manager

Contents

1.0	Introduction	1-1
1.1	Objective and Approach	1-2
1.2	Document Organization.....	1-3
2.0	Selection of Compounds of Potential Concern.....	2-1
2.1	Risk Assessment Dataset.....	2-1
2.2	Screening for COPC Determination	2-2
2.2.1	Background Comparison	2-2
2.2.2	Detection Frequency	2-3
2.2.3	Human Health Screening Levels.....	2-3
2.2.4	Comparison to Screening Levels	2-4
2.3	Determination of Vapor Intrusion COPC.....	2-5
2.4	Summary of COPCs.....	2-6
3.0	Exposure Assessment	3-1
3.1	BNSF Mission Wye History.....	3-1
3.2	Current and Reasonably Anticipated Future Use	3-1
3.3	Site Conceptual Exposure Model.....	3-2
3.4	Potential Receptors.....	3-2
3.5	Exposure Assumptions.....	3-3
3.6	Calculation of Intake Factors.....	3-3
3.6.1	Soil.....	3-4
3.7	Absorption Factors.....	3-5
3.7.1	Oral	3-5
3.7.2	Dermal.....	3-5
3.7.3	Inhalation.....	3-6
3.8	Compounds with a Mutagenic Mode of Action	3-6
3.9	Exposure Areas and Exposure Point Concentrations.....	3-6
4.0	Fate and Transport	4-1
4.1	Vapor Intrusion into Indoor Air	4-1
4.2	Ambient Air	4-1
4.3	Leaching to Groundwater	4-2
5.0	Toxicity Assessment	5-1
6.0	Human Health Risk Characterization	6-1

6.1	Methodology for Characterization of Potential Human Health Risks.....	6-1
6.1.1	Non-carcinogenic Risk.....	6-1
6.1.2	Carcinogenic Risk.....	6-1
6.2	Risk Evaluation for Soil.....	6-2
6.2.1	Future Commercial/Industrial Worker.....	6-2
6.2.2	Future Construction/Excavation Worker.....	6-2
6.2.3	Current and Future Visitor/Trespasser, Adolescent.....	6-2
6.2.4	Future Resident, Adult and Child.....	6-3
6.3	Risk Evaluation for Groundwater.....	6-3
6.4	Leaching Evaluation.....	6-3
6.5	Vapor Intrusion Risk Evaluation.....	6-1
7.0	Uncertainty Analysis.....	7-1
8.0	Development of Cleanup Levels.....	8-1
8.1	Cleanup Levels for Non-carcinogenic Compounds.....	8-1
8.2	Cleanup Levels for Carcinogenic Compounds.....	8-2
8.3	Summary of Cleanup Levels.....	8-2
9.0	Summary and Conclusions.....	9-1
10.0	References.....	10-1

List of Appendices

Appendix A Analytical Datasets Used in the Risk Assessment

Appendix B ProUCL Outputs

Appendix C Chemical-Specific Intake Factors and Pathway-Specific Cleanup Levels

Appendix D Calculation of Site-Specific Soil Cleanup Levels Considered Protective of Groundwater via Leaching

List of Tables

Table 2-1	Summary of Soil Background Values
Table 2-2	Human Health Screening Levels for Soil
Table 2-3	Human Health Screening Levels for Groundwater
Table 2-4	Occurrence, Distribution and Selection of Compounds of Potential Concern in Surface Soil
Table 2-5	Occurrence, Distribution and Selection of Compounds of Potential Concern in Surface Soil
Table 2-6	Evaluation of SPLP Data for Further Refinement of Leaching Compounds of Potential Concern
Table 2-7	Occurrence, Distribution and Selection of Compounds of Potential Concern in Groundwater
Table 3-1	Exposure Assumptions for the Future Commercial/Industrial Worker
Table 3-2	Exposure Assumptions for the Future Construction/Excavation Worker
Table 3-3	Exposure Assumptions for the Future Visitor (Trespasser), Adolescent 6-18 Years
Table 3-4	Exposure Assumptions for the Future Resident, Adult and Child 0-6 Years
Table 3-5	Exposure Point Concentrations for Soil Compounds of Potential Concern
Table 5-1	Toxicity Values and Chemical-Specific Properties for Soil Compounds of Potential Concern
Table 6-1	Surface Soil Risk Estimates for the Future Commercial/Industrial Worker
Table 6-2	Soil Risk Estimates for the Future Construction/Excavation Worker
Table 6-3	Surface Soil Risk Estimates for the Future Visitor/Trespasser, Adolescent
Table 6-4	Surface Soil Risk Estimates for the Future Resident, Adult and Child
Table 6-5	Groundwater Locations Exceeding DEQ-7 Standards July 2010 to July 2013
Table 6-6	Evaluation of Soil Locations Exceeding Site-Specific Leaching Cleanup Levels
Table 7-1	Uncertainties Associated with the Human Health Risk Assessment
Table 8-1	Summary of Site-Specific Cleanup Levels

List of Figures

- Figure 2-1 Surface Soil Samples Used in the Risk Assessment
- Figure 2-2 Subsurface Soil Samples Used in the Risk Assessment
- Figure 2-3 Groundwater Locations Used in the Risk Assessment
- Figure 3-1 Mission Wye Layout
- Figure 3-2 Updated Human Health Site Conceptual Exposure Model
- Figure 6-1 Soil Location(s) Driving Exceedances of Acceptable Risk Levels
- Figure 6-2 Exceedances of DEQ-7 Standards in Groundwater
- Figure 6-3 Soil Locations Exceeding Site-Specific Cleanup Levels Considered Protective of Groundwater via Leaching

List of Acronyms and Abbreviations

µg/L	Micrograms per liter
µg/m ³	micrograms per cubic meter
1,2-DCB	1,2-dichlorobenzene
1,4-DCB	1,4-dichlorobenzene
AAF	absorption adjustment factor
ABS _d	dermal absorption factor
ADAF	Age-dependent adjustment factor
AECOM	AECOM Technical Services, Inc.
ALS	asphalt-like substance
BAF	bioavailability factor
bgs	below ground surface
BNSF	BNSF Railway Company
BW	body weight
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	compound of concern
COPC	compound of potential concern
CSF	cancer slope factor
DAF	dilution attenuation factor
DF	detection frequency
DNA	deoxyribonucleic acid
ED	exposure duration
EFH	exposure factors handbook
ENSR	ENSR Corporation
EPC	exposure point concentration
EPH	Total extractable petroleum hydrocarbons
ERCL	environmental requirements, criteria, or limitations
FAQ	frequently asked questions
FS	Feasibility Study
GIABS	Gastrointestinal absorption
HEAST	Health Effects Assessment Summary Table
HHRA	human health risk assessment
HI	hazard index
HQ	Hazard quotient
IF	Intake factor
IRIS	Integrated Risk Information System
kg	kilogram
MCL	maximum contaminant levels
MDC	maximum detected concentration
MDEQ	Montana Department of Environmental Quality
mg/kg day	milligrams per kilogram day

mg/m ³	milligrams per cubic meter
MNA	monitored natural attenuation
MOA	Mode of action
MRL	maximum reporting limit
NWI	National Wetland Inventory
OSRTI	Office of Superfund Remediation and Technology Innovation
PAH	polycyclic aromatic hydrocarbon
PC	permeability constants
PCE	tetrachloroethene or tetrachloroethylene
PEF	particulate emission factor
PEMA	palustrine, emergent, temporary flooded
ppm	parts per million
PPRTV	Provisional Peer Reviewed Toxicity Values
PUBKx	palustrine, unconsolidated bottom, artificially flooded, excavated
RA	risk assessment
RAF	relative absorption factors
RAGS	risk assessment guidance for superfund
RBCA	Risk-Based Corrective Action
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
RETEC	Remediation Technologies, Inc. or The RETEC Group, Inc.
RfC	reference concentration
RfD	reference dose
RFI	RCRA facility investigation
RI	remedial investigation
ROW	right of way
RRA	Revised Risk Assessment
RSL	Regional Screening Level
SCEM	Site Conceptual Exposure Model
SPLP	Synthetic Precipitation Leaching Procedure
SQL	sample quantitation limit
SSL	soil screening levels
SSSL	site-specific screening level
T&E	threatened and endangered
TPH	total petroleum hydrocarbon
TAL	target analyte list
TCE	trichloroethene or trichloroethylene
TRL	target risk level
UCL	upper confidence level
URF	unit risk factor
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VF	volatilization factor
VMP	vapor monitoring point

VOC

volatile organic compound

1.0 Introduction

This Human Health Risk Assessment (HHRA) Amendment presents an evaluation of the potential risk to human health at the Mission Wye facility¹ in Livingston, Montana, and implements the approach and methodology defined in the Mission Wye Risk Assessment (RA) Work Plan (RA Work Plan). The RA Work Plan was provided as Appendix C to the Feasibility Study (FS) Work Plan (AECOM 2013a) and was approved by the Montana Department of Environmental Quality (MDEQ) April 11, 2013 (MDEQ 2013a). The RA Work Plan was developed to provide the approach and methods necessary for review and update of the approved *Revised Risk Assessment* (RRA) (Remediation Technologies, Inc. or The RETEC Group, Inc. [RETEC 1993]) based on current conditions. This HHRA Amendment has been prepared by AECOM Technical Services, Inc. (AECOM) on behalf of BNSF Railway Company (BNSF) in response to Exhibit IV of the 1990 Modified Partial Consent Decree (CD) (United States District Court for the District of Montana [D. Mont.] 1990) and subsequent correspondence between the MDEQ and BNSF (MDEQ 2012a, b, 2005).

As required by Exhibit IV of the CD, the HHRA Amendment was conducted based on a revised Site Conceptual Exposure Model (SCEM), updated toxicity and exposure parameters, and risk equations, with a goal of evaluating risk and developing site-specific cleanup levels for consideration in risk management decisions in the FS. Review and approval of site-specific cleanup levels by MDEQ prior to selection of remedial alternatives was specified as an objective in the CD. Implementation of the RA Work Plan provided the information necessary to meet the requirements provided in the CD. The RA process often uses the term chemical; however, for this HHRA Amendment, the term compound is interchangeable.

Based on current conditions, there is little potential for significant exposure to ecological receptors that may access the property, as overall use by wildlife is expected to be low and the spatial extent of soil impacts is limited and localized. Furthermore, migration of soil impacts out of the source area via erosion or overland transport and/or via groundwater migration is minimal based on existing data and is considered insignificant from an ecological risk perspective. The RA Work Plan presented a supplemental qualitative ecological RA. A qualitative ecological assessment was conducted as part of the RRA and concluded at that time that there is a low potential for ecological risk, primarily for mammals and birds, through direct contact with surficial waste (RETEC 1993). Acknowledging that a large-volume (36,900 tons) of the waste was removed during the interim remedial action (AECOM 2012), the potential for ecological risk was re-evaluated based on current conditions. To that end, an updated list of threatened and endangered species and state sensitive species within a 4-mile radius of BNSF Mission Wye was obtained from the Montana Natural Heritage Program and evaluated. In addition, ecological screening levels were compared to current compounds of concern (COC) concentrations and an updated qualitative ecological risk evaluation was included in the RA Work Plan report (AECOM 2013a). The conclusions presented therein were consistent with those determined previously and the reader is referred to the approved RA Work Plan document for further detail. Should conditions change, further assessment of potential ecological exposures may be warranted. No further discussion of ecological endpoints is included in this document.

¹ The facility was defined in the Consent Decree as "the Facility located in the northwest quarter of Section 35, Range 10 East, Township 1 South, in Park County approximately four miles northeast of Livingston, Montana. The site is on the south side of the Yellowstone River inside the triangular area of a Y-shape junction or "Wye" of two Burlington Northern Railroad lines."

1.1 Objective and Approach

The primary objective of an RA is the protection of human health and the environment with respect to potential exposure to compounds in soil and groundwater based on current and reasonably anticipated future land uses. The objectives also include the protection of groundwater via leaching.

The specific objectives of this HHRA Amendment were the following.

- Define potential human health risk under current and reasonably anticipated future land use.
- Define areas where No Further Action is warranted.
- Define areas where additional data collection and/or remedial action may be required.

This HHRA Amendment followed the MDEQ and United States Environmental Protection Agency (USEPA) guidance as appropriate. Specifically, this HHRA Amendment utilized methodologies for determining site-specific human health risk estimates and cleanup levels that are consistent with current *Montana Tier 1 Risk Based Corrective Action Guidance for Petroleum Releases* (MDEQ 2009) in addition to other MDEQ guidance (MDEQ 2012c,d, 2007, 2005) and USEPA guidance (USEPA 2012, 2011a, 2011b, 2009, 2004, 2002a,b, 1996a, 1991, 1989). Evaluating the cumulative risk for multiple receptor scenarios aids in the risk-based decision making process and the development and selection of appropriate site-specific risk-based cleanup levels.

The elements of this HHRA Amendment were consistent with USEPA's *Risk Assessment Guidance for Superfund* (RAGS) process (USEPA 1989) and included the following.

- Selection of human health compounds of potential concern (COPCs) based on available soil and groundwater data.
- Assessment of human health exposure, including development of a SCEM that identifies potential sources, migration routes, exposure pathways and receptors.
- Assessment of human health toxicity.
- Characterization of potential human health risks based on MDEQ's acceptable cumulative cancer target risk level (TRL) of 1×10^{-5} and hazard index (HI) of 1.0.
- Analysis of uncertainty.

The process for considering each of these elements in this HHRA Amendment, along with evaluation of leaching to groundwater and vapor intrusion, is presented in the sections below. The approach for evaluating the potential for soil impacts to leach to groundwater included the following.

- Comparison of unsaturated soil data to MDEQ and USEPA default soil screening levels (SSLs) considered protective of groundwater via leaching to determine COPC (see ARM 17.55.109).
- Collection of synthetic precipitation leaching procedure (SPLP) data to further assess leaching potential.
- Calculation of site-specific leaching cleanup levels (including consideration of background levels for inorganics).
- Review of potential leaching COPC detected in groundwater. The leaching component for the RA is addressed in Sections 2.3, 4.3 and 6.4.

To determine whether vapor intrusion of subsurface volatiles may occur in the event that future buildings are constructed on or adjacent to the railroad owned property, analytical results from the vapor monitoring points (VMPs) were evaluated using the following lines-of-evidence approach.

- Comparison of detected soil vapor concentrations to MDEQ-approved soil vapor screening levels consisting of USEPA's residential and industrial indoor air screening levels (MDEQ 2011, USEPA 2014b).
- Review of the distribution of COPC concentrations within the vadose zone.
- Review of the composition of COPCs present in soil vapor compared to composition of COPCs present in groundwater and/or soil.

The approach for evaluating vapor intrusion risk was consistent with the MDEQ approved Soil Vapor Sampling and Analysis Plan, which was provided as Appendix B of the FS Work Plan (AECOM 2013a) and was conducted in accordance with the *Montana Vapor Intrusion Guide* (MDEQ 2011). Further detail and information is available in the Soil Vapor Monitoring and Vapor Intrusion Evaluation Report (AECOM 2013b).

1.2 Document Organization

This document is organized as follows: Chapter 2.0 describes the selection of the COPCs. The exposure assessment is discussed in Chapter 3.0. Chapters 4.0, 5.0 and 6.0 discuss fate and transport, toxicity assessment, and risk characterization, respectively. Chapter 7.0 presents an uncertainty analysis discussion. Chapter 8.0 presents the development of site-specific cleanup levels. Chapter 9.0 summarizes the results and draws conclusions. References are provided in Chapter 10.0.

2.0 Selection of Compounds of Potential Concern

The selection process for determining compounds of interest uses the USEPA Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) (USEPA 1989) and the Frequently Asked Questions available on the MDEQ website (MDEQ 2012c). The COPCs for BNSF Mission Wye have been identified using representative and adequate datasets and a screening process. By using this screening process to eliminate compounds that do not exceed acceptable levels, further investigations and risk evaluations are focused, thus streamlining the Comprehensive Environmental Cleanup and Responsibility Act (CECRA) remedial investigation/feasibility study (RFI/FS) process (USEPA 1989).

In general, the initial COPC screening process evaluates data from soil and groundwater samples and compares these data to conservative relevant screening levels and criteria that are, according to the USEPA or MDEQ, protective of human health. Those COPCs retained following this screening evaluation are included in the quantitative RA. Identification of COPCs does not automatically indicate that the analytes are a concern for human health, as screening levels are not specific to the facility. Compounds retained as COPCs are evaluated in more detail in the site-specific risk evaluation.

At the initial COPC selection stage of the investigation, screening concentrations are used to compare to relevant media-specific screening criteria. This comparison focuses the remainder of the investigation on only those areas and media where COPCs are of potential concern. The steps for the COPC selection process specifically include the following.

- Determination of exceedance of natural background concentrations (shown on **Table 2-1**).
- Evaluation of detection frequency.
- Comparison of data to default screening levels, which are shown in **Tables 2-2** and **2-3** for soil and groundwater, respectively.

These steps are summarized in the following subsections.

2.1 Risk Assessment Dataset

Extensive remedial actions have been completed as discussed in Chapter 2.0 of the FS Work Plan. The 1995 Interim Action Memorandum and 2000 Interim Action Memorandum Addendum specifically included details on excavation, processing and treatment of source material to meet remediation goals and legal requirements (MDEQ 2000, 1995). Specifically, clay source material, asphalt-like substance (ALS), and impacted soil were excavated from the North, South, Center and East cells, and from the ALS and Seep Areas. BNSF completed the work requested by the MDEQ from 1995 through 2000 and collected additional confirmation samples in 2007 (ENSR 2007). The majority of soil exceeding regional screening levels (RSLs) was excavated and disposed along with other soil to varying depths across the property. The analytical datasets used in the RA are provided in **Appendix A** and are discussed below.

Excavated soil analytical results were removed from the RA dataset since the soil was excavated from 1996 through 2000 and is no longer in place. The dataset currently available for use in the RA consists of one background sample (TP-BKG) collected during the 1993 RA (for screening purposes), confirmation soil samples collected from the excavated areas in 1997 and 2000, and test pit samples collected in 2007 to confirm the extent of previous excavations was sufficient. Additional soil samples were also collected in July 2013 along with data submitted for SPLP analysis. Two locations were selected for SPLP analysis (VMP-1D and VMP-2D) and samples were collected in both surface and subsurface intervals (i.e., 0.5-1.5 feet below ground surface [bgs] and 4 to 9 feet bgs). Note, soil vapor samples were also collected at two depths within each of the two soil VMPs (VMP-1 and VMP-2) on July 30, 2013 (see the Soil Vapor Monitoring and Vapor Intrusion Report for details [AECOM 2013b]). **Appendix A** presents

the 1997, 2000, 2007, and 2013 soil sample results, which represent the current dataset used in the risk assessment.

Groundwater data included in the RA consist of data collected from monitoring wells over the last 4 years (i.e., 2010, 2011, 2012 and 2013). This groundwater dataset is considered to be the most representative of current conditions and yields the spatial coverage and distribution required for evaluation of the complete exposure pathways.

Figure 2-1 through **Figure 2-3** depict the sample locations used in the RA for surface soil, subsurface soil and groundwater, respectively. **Figure 2-2** shows the locations of the areas excavated in 1997 and 2000 and the 2007 test pits; grab samples were collected from the bottom of the excavated areas and were composited. Five sample aliquots were collected from each sampling location, placed in individual jars and composited at the laboratory, with the exception of location SS-88 for which four aliquots were composited. One aliquot (Sample SS-88d) was analyzed individually due to darker soil staining observed in the field, as requested by the MDEQ project officer.

Surface soil samples are considered from 0 to 2 feet bgs and subsurface soil begins at 2 feet bgs (MDEQ 2009). However, the depth of sample numbers ALSAB-1 through ALSAB-4 collected from the sidewalls was 0 to 3 feet bgs and, as a result, the samples were considered to be subsurface in the RA. The interval of these samples is considered inappropriate per MDEQ guidance because it combines surface and subsurface soils, which present different exposure scenarios for direct contact and subsequent risks and results in a low level of uncertainty in the RA. If soil samples are collected during future site activities, an effort will be made to limit the collection interval from 0 to 2 feet bgs or from 2 feet bgs and greater.

2.2 Screening for COPC Determination

Screening concentrations were based on analytical data measured in media of concern (e.g., surface soil [0 to 2 feet bgs, subsurface soil [0 to 10 feet bgs], and groundwater). The concentrations selected for screening were defined as the maximum detected concentration (MDC) for detected analytes, and the maximum reporting limit (MRL) for non-detected analytes.

2.2.1 Background Comparison

Similar to the 1993 RRA (RETEC 1993), the first step of the screening process compared detected COPC concentrations to background concentrations where available (MDEQ 2012c). Those COPCs with concentrations at or below applicable background were eliminated from further evaluation in the HHRA Amendment.

One background sample (TP-BKG) was collected during the 1993 RA and analyzed for organics and metals from three depth intervals (surface, vadose, and saturated); however, all organic data was non-detect. As a result, background data for screening purposes are only available for metals. The results of background monitoring are provided in **Table 2-1** and the background concentrations of metals for surface soils were used for screening purposes. If a metal was not detected in the background dataset (i.e., antimony, cadmium etc.), the MDEQ literature values for inorganic background concentrations in soil were utilized and were obtained from Table 4-4 of the *Background Concentrations of Inorganic Constituents in Montana Surface Soils* (MDEQ 2013b²). These values background concentration values were based on the background threshold values (BTVs) calculated from the available dataset using ProUCL version 5.0. Those analytes with MDCs at or below available

² MDEQ proposes to amend ARM 17.55.109 through incorporation by reference values presented in Table 4-4 of the September 2013 *Background Concentrations of Inorganic Constituents in Montana Surface Soils*. A public comment period on the proposed rule change extends through April 14, 2014.

background levels or relevant screening levels were eliminated from further evaluation in the COPC selection process.

The comparison of soil data to naturally occurring background levels was used to screen out compounds early in the RA process. However, as suggested in USEPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sites* (USEPA 2002a), background levels were also used for comparison to average concentrations (as represented by the 95 percent upper confidence limit [UCL]) as a step in the risk characterization process.

2.2.2 Detection Frequency

Similar to the 1993 RRA (RETEC 1993), the next step of the screening process evaluated the detection frequency (DF) for a given COPC in each media. The COPC guidance recommends that detected analytes with a DF of less than 5 percent in each media not be considered COPCs because they are unlikely to cause significant adverse health effects (USEPA 1994). All COPCs eliminated in this step (i.e., with a DF less than 5 percent in each media) were reviewed to ensure that isolated elevated compound concentrations ("clusters" or hot spots) were not prematurely eliminated, if in fact, conditions indicated they should be retained for further risk evaluation.

In addition, to evaluate adequacy of quantitation limits, compounds that were not detected (i.e., 100 percent non-detect) were retained for comparison to applicable screening levels. Compounds with a MRL above screening levels were identified and discussed qualitatively in the uncertainty section.

2.2.3 Human Health Screening Levels

In the final screening step, the maximum detected concentrations for surface soil, subsurface soil and groundwater were compared to various USEPA and state-specific screening levels. Screening levels are considered protective because they assume upper bound levels of exposure protective of any land use (e.g., unrestricted use). By screening compounds against these health-protective values, the remainder of the work was focused on those areas and media where compounds were more likely to warrant corrective measures. In accordance with the USEPA guidance for RA (USEPA 1989), only analytes that exceeded screening criteria, and for which complete or potentially complete exposure pathways may exist, were carried forward in the RA process. As previously stated, compounds that exceeded the screening levels were considered COPCs and were retained for further evaluation in this HHRA Amendment. A compound that did not exceed the human health-based screening levels was eliminated from the process and not evaluated further.

The sources of screening values for the COPC selection process considered current soil and groundwater screening values for Montana and the USEPA. Although future land use is expected to remain consistent with current use (i.e., vacant commercial/industrial), residential screening levels for groundwater and soil (in addition to industrial screening levels) were included for the initial COPC screen as no restrictions are currently in place to prevent future residential use.

The following screening levels were implemented (for all media of concern) for the purposes of this HHRA Amendment:

- **Soil.** Exhibit IV of the 1990 CD and MDEQ's soil screening flowchart (available on-line at http://deq.mt.gov/StateSuperfund/VCRA_Guide/ss_flowchart.pdf) were used to identify the appropriate screening levels. The MDEQ's residential and industrial Tier 1 risk-based screening levels (RBSLs) for surface and subsurface soil were utilized (MDEQ 2009, Tables 1 and 2). If a Tier 1 RBSL was not available, the USEPA's residential and industrial soil RSLs were applied (USEPA 2014b). To account for additive risk, the USEPA's RSLs for non-carcinogens were considered at 0.1 times their listed values, consistent with MDEQ methodology. Soil screening levels are provided in **Table 2-2**. In addition, as the final site-specific cleanup levels need to be

protective of leaching to groundwater, comparison of data to default leaching criteria was conducted, as discussed below.

- **Leaching.** The MDEQ Tier 1 Risk-Based Corrective Action (RBCA) program has developed RBSLs for the protection of groundwater for a select list of petroleum compounds (MDEQ 2009; Appendix C). The MDEQ soil screening process states that if a Tier 1 leaching RBSL is not available, then USEPA's maximum contaminant levels (MCL)-based protection of groundwater SSLs may be applied. Similarly, if an MCL-based SSL is not available, then USEPA's risk-based SSLs can be utilized. The USEPA's RSL Table contains SSLs considered protective of groundwater via leaching (USEPA 2014b). The USEPA default migration to groundwater screening levels are conservatively based on a dilution attenuation factor (DAF) of 1.0 and have been calculated in accordance with the fate and transport model equations and default input parameters presented in USEPA's *Soil Screening Guidance* (USEPA 2002b, 1996a). MDEQ allows the USEPA SSLs to be adjusted to a state-wide DAF of 10 for comparison to data; which was done for screening purposes. The above mentioned hierarchy of sources reflects the latest available guidance for applicable leaching requirements and is consistent with those specified in Exhibit IV to the 1990 CD. The leaching screening levels are presented in **Table 2-2**. The models and input parameters used to derive leaching screening levels were discussed in detail in Appendix C of the MDEQ-approved FS Work Plan (AECOM 2013a).
- **Groundwater.** Per direction from MDEQ, the following screening levels are appropriate for groundwater: MDEQ's Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ-7), Groundwater Human Health Standards (MDEQ 2012d); Tier 1 Groundwater RBSLs (MDEQ 2009); and USEPA's RSLs for Tapwater (USEPA 2014b). These values were compared directly to groundwater concentrations. Groundwater screening levels are presented in **Table 2-3**.
- **Soil Vapor.** Consistent with MDEQ vapor intrusion guidance, USEPA's risk-based indoor air screening levels (i.e., RSLs) for both a residential and industrial exposure scenario were used for comparison to soil vapor data (MDEQ 2011, USEPA 2014b). The RSLs were based on a target risk level of 1×10^{-6} and target non-cancer hazard quotient (HQ) of 0.1. Note, this comparison was made in the Soil Vapor Monitoring and Vapor Intrusion Evaluation Report, and is not presented in this risk assessment (AECOM 2013b). The results of the soil vapor screening process are discussed in Section 2.3 below.

2.2.4 Comparison to Screening Levels

A comparison of the MDC and MRL for each analyte to the screening levels is discussed below by media. Analytes where the MDC exceeded the screening level were retained as COPCs for further quantitative evaluation in the risk characterization. Analytes where the MDC or MRL (for non-detected analytes) was below the screening level were eliminated from further consideration. If the MRL for a non-detected analyte was above the SL, or a SL was not available, these analytes are discussed qualitatively in the uncertainty analysis in Chapter 7.0 and in **Table 7-1**. By reducing the COPC list based on these criteria, the remainder of this HHRA Amendment is focused on those compounds associated with the majority of potential risk from each source area.

Determination of Soil COPC

Table 2-4 presents the surface soil COPC for future residents, visitor/trespassers and commercial/industrial workers. As shown on **Table 2-4**, surface soil COPC consist of two analytes: tetrachloroethene (PCE) and trichloroethene (TCE).

Subsurface soil COPC for the construction worker scenario is summarized in **Table 2-5**. Similar to surface soil, this list consists only of PCE and TCE.

Total extractable petroleum hydrocarbons (EPH) were identified as a COPC in both surface and subsurface soils. The EPH sample was fractionated in accordance with MDEQ guidance (MDEQ 2012d).

EPH fractionated data do not exceed their respective soil screening levels; as a result, total EPH is not identified as a COPC and does not require further evaluation.

Determination of Leaching COPC

Preliminary soil COPC for the leaching pathway are summarized on **Table 2-5**. As shown on **Table 2-5**, eight analytes were reported to have an MDC above default leaching SSLs. However, four of these (1,2-dichlorobenzene, 1,4-dichlorobenzene, m,p-xylenes, and methylene chloride) were detected in less than 5 percent of the samples analyzed (i.e., 1 to 2 out of 80 samples) and therefore were not retained as leaching COPC. In addition to being infrequently detected in soil samples (DF= 1.3 percent), methylene chloride is a common lab contaminant and is not expected to be present samples collected from BNSF Mission Wye.

To further evaluate the leaching pathway and refine the initial list of COPCs, SPLP analysis was conducted on soil samples collected as part of the vapor monitoring program. The SPLP results below groundwater screening levels are an indication that the mobility of compounds in vadose zone soil is negligible and not a leaching concern. The SPLP results were compared to groundwater standards and summarized on **Table 2-6**. The results of the SPLP analysis indicate that 1,2-dichlorobenzene (1,2-DCB) and 1,4-dichlorobenzene (1,4-DCB) were not leaching COPC as they were not detected in leachate samples at reporting limits below groundwater screening levels (i.e., DEQ-7 standards). The SPLP results in conjunction with infrequent detections in soil (DF = 2.4 percent), indicate 1,2-DCB and 1,4-DCB are not leaching COPC and they not evaluated further. While PCE and TCE were also not detected in SPLP results, the reporting limits achieved were not adequate to meet the groundwater screening levels. Therefore, PCE and TCE may have been present in leachate at concentrations below the reporting limit that could not be detected by the analytical instrument. As a result, SPLP results were deemed inconclusive for PCE and TCE at this time and these analytes were retained as leaching COPC for further evaluation in the RA on the basis that they are known compounds of concern in both soil and groundwater. Concentrations of iron and manganese in leachate were above groundwater screening levels and site-specific soil background levels.

Overall, the outcome of the leaching COPC selection process determined that four analytes (PCE, TCE, iron and manganese) in soil may potentially be leaching to groundwater and they were retained as leaching COPC for further evaluation in this HHRA Amendment. The approach for further addressing the leaching pathway in an RA is provided in Section 4.3 and the outcome of the leaching evaluation is presented in Section 6.4.

Determination of Groundwater COPC

As shown on **Table 2-7**, PCE and TCE are retained as COPCs for groundwater.

2.3 Determination of Vapor Intrusion COPC

The results of the Soil Vapor Monitoring and Vapor Intrusion Evaluation Report were used to identify vapor intrusion COPCs (AECOM 2013b). A sample by sample comparison of detected soil vapor concentrations to risk-based indoor air screening levels was performed.

The following COPCs were detected in soil vapor samples above the associated *indoor air* screening level (for a residential and/or industrial exposure scenario, as indicated) in at least one of the two soil vapor locations (VMP-1 and VMP-2):

- 1,2,4-Trimethylbenzene – VMP-2 only; residential and industrial scenario. Although this COPC was not detected at VMP-1, laboratory RLs at VMP-1 were above screening levels.
- trans-1,2-DCE – VMP-1 only; residential and industrial scenario.
- TCE and PCE – VMP-1 and VMP-2; residential and industrial scenario.

For informational purposes, the Soil Vapor Monitoring and Vapor Intrusion Evaluation Report also compared detected soil vapor concentrations to USEPA's Vapor Intrusion Screening Levels (VISLs) for soil vapor (USEPA 2013), which were derived by USEPA by dividing the indoor air RSLs by a generic and conservative attenuation factor of 0.1. This comparison, although not required by the MDEQ and not used by MDEQ for decision-making, was performed to provide an additional line of evidence of whether the vapor intrusion pathway may pose a potential health risk above target levels under a hypothetical future use scenario. Comparison to the soil vapor screening levels indicated only 1,2,4-trimethylbenzene would be eliminated as a COPC.

The results of the comparisons of soil vapor data to the risk-based screening levels for indoor air indicate that PCE, TCE, 1,2,4-trimethylbenzene, and trans-1,2-DCE are present in soil vapor at concentrations that may pose a potential risk/hazard above target levels to occupants in the event that buildings are constructed on or adjacent to the BNSF property in the future. Therefore, PCE, TCE, 1,2,4-trimethylbenzene, and trans-1,2-DCE were retained for further evaluation in the risk assessment.

2.4 Summary of COPCs

The outcome of the COPC selection process is a set of COPCs in each medium that was retained for further evaluation in the RA. Currently, the COPCs include two chlorinated solvents (TCE and PCE) as soil COPCs; two chlorinated solvents (TCE, PCE) and two inorganic compound (iron and manganese) as leaching COPCs; two chlorinated solvents (TCE, PCE), one aromatic hydrocarbon (1,2,4-trimethylbenzene) and one organochloride (trans-1,2-DCE) as an indoor air COPC, and two chlorinated solvents (TCE and PCE) as groundwater COPCs.

3.0 Exposure Assessment

This Exposure Assessment summarizes how site-specific pathways, receptors and exposure assumptions were used in the development of this updated HHRA Amendment. Much of the exposure information is built upon in the 1993 RRA (RETEC 1993) with updates to reflect changes in current and reasonably anticipated future uses, as well as incorporation of the vapor intrusion exposure pathway.

3.1 BNSF Mission Wye History

BNSF Mission Wye consists of an inactive, 7-acre industrial landfill that operated from approximately 1955 to 1979 and was used for disposal of acid clay filtration material from a lube oil reclamation facility and debris generated at the Livingston Rail Yard. A review of ownership records, prior to installation of the vapor monitoring points, revealed a prior sale of the northern portion of the former BNSF-owned Mission Wye property to MRL; the southern portion is included in the right-of-way leased to MRL by BNSF. This is a change from historical presentation of the property ownership (e.g., Appendix C of the FS Work Plan). The text and figures now refer to this area as “railroad-owned” instead of “BNSF-owned”. The figures also show the extent of the railroad owned property, including the right-of-way along the railroad tracks, in addition to the portion defined as the Mission Wye facility in the CD.

The acid clay sludge (clay source material) was placed in trenches, or cells, and when a cell was filled with sludge to within 2 to 3 feet of the top, it was covered with clean soil and a new cell was excavated. The clay material was disposed of in four cells (designated North, Center, South and East cells).

Figure 3-1 presents the BNSF Mission Wye layout as it appeared during interim action activities. Per the *Phase I Report Mission Wye Remedial Investigation (Phase I Report)* (RETEC 1992), the North Cell was constructed and filled first, followed by the South, Center, and East cells. Waste disposal ceased in 1977.

The clay material contained elevated levels of VOCs including TCE and PCE, as well as toluene, ethylbenzene and xylenes. Low concentrations of metals and polycyclic aromatic hydrocarbons (PAHs) also were found to be present in clay waste samples. The pH in the clay material found in the cells was low because of the sulfuric acid used in the reclaiming process. The North, Center and South cells contained a layer of water perched on the clay material. The perched water contained hydrocarbons, metals, and other organic compounds. The clay material and the perched water were removed during the interim removal action.

The asphalt-like substance (ALS) was identified in two areas referred to as “the North Parking Lot” and “Seep Area.” The ALS material was predominantly heavy-end hydrocarbons and organic compounds, including chlorinated VOCs. The TCE was the predominant VOC detected. The ALS was removed during the interim removal action.

3.2 Current and Reasonably Anticipated Future Use

The railroad-owned property is vacant and is surrounded by rural land. There are no existing structures on the railroad-owned or adjacent property located west of Highway 89. No future development is planned on the property; however, to conservatively evaluate risks posed by remaining COPCs, future residential use is assumed. BNSF may propose institutional controls limiting development on railroad property in the future. Groundwater is not currently used on the railroad-owned or adjacent property located west of Highway 89. East of Highway 89, groundwater use downgradient of BNSF Mission Wye is limited to domestic wells that are located between 850 feet and 1 mile downgradient of the former waste cells.

3.3 Site Conceptual Exposure Model

The SCEM provides a graphical depiction of conditions at Mission Wye, identifying known or suspected sources of contamination, potential chemical transport and exposure pathways, and receptors. Tracking of chemical migration from sources to environmental receptors is one of the most important uses of the SCEM and forms the basis from which risk-based decisions are evaluated. In addition, the SCEM is an important tool used to determine whether more data are needed.

Potentially complete exposure pathways are evaluated for RA purposes. A complete exposure pathway includes the following elements:

- A source and mechanism of a COPC release;
- A transport or contact medium (e.g., groundwater or soil);
- An exposure point where humans can contact the contaminated medium; and
- An exposure (intake) route (such as ingestion, dermal contact or inhalation).

If any one of these elements is absent, the exposure pathway is considered incomplete. Where there is no potential human exposure, there is no potential human health risk.

Figure 3-2 presents the SCEM for potential receptors and is built upon the receptors and exposure pathways presented in the 1993 RRA (RETEC 1993), as well as hypothetical future vapor intrusion pathways. The following subsections focus on those potential receptors and pathways for which complete and significant pathways exist.

3.4 Potential Receptors

The property will likely remain vacant and immediate adjoining land use is expected to remain undeveloped. Regardless, hypothetical future scenarios were evaluated in the event that a commercial or industrial building is constructed or residential development occurs:

- **Current and Future Construction/Excavation Worker.** Under current and future conditions, this receptor may perform construction and excavation activities throughout the property and contact both surface and subsurface soils (0-10 feet bgs). Therefore, the soil pathways evaluated for the construction/excavation worker include ingestion, dermal contact and inhalation of soil particulates/vapors. Additionally, as the depth to groundwater is shallow under portions of the property (i.e., as shallow as 2.56 feet bgs recorded in 2011), dermal contact with groundwater may occur during excavation activities.
- **Future Commercial/Industrial Worker.** Assuming potential future commercial/industrial use of the property, worker exposures are limited to direct contact (incidental ingestion and dermal contact) with surface soil and groundwater, in addition to inhalation of particulates/vapors from surface soil. Note that surface soil is defined as 0 to 2 feet bgs. Assuming a hypothetical, future maintenance/office building is constructed on the property, future workers would potentially be exposed to subsurface vapors migrating inside the building. Therefore, the worker could inhale indoor air volatiles originating from subsurface media (e.g., subsurface soil and groundwater).
- **Future Visitor (Trespasser), Adolescent.** If future residential development were to occur nearby or on the property, neighboring adolescent residents could trespass onto the railroad-owned property, although the railroad-owned property is currently fenced. Potential future trespasser exposures are limited to incidental ingestion, dermal contact with surface soil, and inhalation of particulates/vapors from surface soil (0 to 2 feet bgs).
- **Future Resident, Child and Adult.** If future residential development were to occur on the property, future resident exposures are limited to direct contact (incidental ingestion and dermal contact) with surface soil (0 to 2 feet bgs) and groundwater, in addition to inhalation of

particulates/vapors from surface soil. Assuming a hypothetical future home is constructed on the property, future residents could potentially be exposed to subsurface vapors migrating inside the home. Therefore, the future resident could inhale indoor air volatiles originating from subsurface media (e.g., subsurface soil and groundwater).

Note, for potential receptors, the inhalation of volatiles in ambient air is considered a complete pathway although exposure is often considered insignificant due to rapid dilution and atmospheric mixing. Exposure assumptions for these receptors used in determining the intake (i.e., dose) are discussed below.

3.5 Exposure Assumptions

The human health exposure assumptions used in the RA are based on a combination of MDEQ and USEPA guidance documents. Specifically, MDEQ RBCA guidance (MDEQ 2009), which incorporates values presented in USEPA guidance (USEPA 2004, 2002b, 1991, 1989) and other sources, as noted was consulted. However, MDEQ is in the process of updating the RBCA guidance with parameters from the 2011 Exposure Factors Handbook (EFH) (USEPA 2011a) and 2011 Highlights of the Exposure Factors Handbook (USEPA 2011b). The MDEQ frequently asked questions (FAQs) reflect the most recent USEPA assumptions given the new 2011 EFH guidance; therefore, the parameters listed in the FAQs web-page were also utilized (MDEQ 2012c). More recently, USEPA has recommended updates to several standard default exposure factors based on the 2011 EFH (USEPA 2014a). These updates have not yet been captured in the FAQs web-page, but have been adopted in the latest May 2014 version of the RSL table (USEPA 2014b) and as such were also used in this HHRA Amendment as appropriate. In addition, the exposure assumptions originally presented in the 1993 RRA (RETEC 1993) were reviewed and utilized if appropriate. Generic exposure assumptions are summarized below.

Body weight (BW) for RA purposes is the average BW over the exposure period. For adults, the mean BW is 80 kilograms (kg), (USEPA 2014a, 2011a, as cited in MDEQ 2012c). For non-adult exposure scenarios, the BW for the child resident 0 to 6 years of age is assumed to be 15 kg (MDEQ 2012c, 2009). For the trespasser exposure scenario, the BW for an adolescent is assumed to be 45 kg, which is the geometric mean of the mean BWs for children between the ages of 6 and 18 years old (MDEQ 2012c).

Averaging time is the period of time for which exposure to COPCs is calculated. For carcinogens, the averaging time is based on the assumption that cancer results from chronic, lifetime exposures to carcinogens. For this reason, the cumulative exposure must be averaged over a lifetime to provide an estimate of increased risk for cancer. Thus, for carcinogenic COPCs, the averaging time is equal to 365 days/year multiplied by the mean life expectancy of 78 years for receptors (USEPA 2014a, 2011a, as cited in MDEQ 2012c). For non-carcinogenic COPCs, the relevant exposure is based on the chronic daily exposure averaged over the exposure period, assuming that effects occur once a threshold dose (from chronic exposure) is reached. Thus, the averaging time for evaluating non-carcinogenic effects is equal to 365 days/year multiplied by the exposure duration (ED).

Table 3-1 through **Table 3-4** present the exposure assumptions for each of the receptors identified and the chronic daily intakes. The intake factor equations are provided below.

3.6 Calculation of Intake Factors

Intake factors related to media-specific exposure pathways consider the frequency that a receptor is expected to contact a particular medium, the duration of that contact, and the mechanisms that enable the chemical to be potentially assimilated by the receptor. For Mission Wye, intake factors are presented for soil in the sections below and reflect current RA guidance methodology. Intake factors are not calculated for groundwater, per MDEQ request, as DEQ-7 standards are applied to address potential future groundwater exposures. Note, as the exposure point concentration (EPC) varies by chemical and

area, it is included as part of the risk calculations presented in Section 6.1 and 6.2 for illustrative purposes instead of the receptor-specific intake factor (IF) equations shown below.

3.6.1 Soil

The incidental ingestion IF for soil is calculated with Equation 1:

$$I_{\text{ingestion}} = \frac{IR * FI * ABS * EF * ED * CF}{BW * AT * 365 \text{ days / year}} \quad (1)$$

Where:

- $I_{\text{ingestion}}$ = Ingestion IF (kg-soil/kg-BW/day)
- IR = Ingestion rate for soil (mg/day)
- FI = Fraction of soil ingested (unit less)
- ABS = Ingestion absorption factor (unit less)
- EF = Exposure frequency (days/year)
- ED = Exposure duration (years)
- CF = Conversion factor (10^{-6} kg/mg)
- BW = Average body weight of the receptor (kg)
- AT = Averaging time of the exposure (years), 78 years for carcinogens and equal to the ED for noncarcinogens

The IF for the soil dermal exposure route is calculated with Equation 2:

$$I_{\text{dermal}} = \frac{BSAE * FC * AF * ABSd * EF * ED * CF}{BW * AT * 365 \text{ days / year}} \quad (2)$$

Where:

- I_{dermal} = Dermal IF (kg-soil/kg-BW/day)
- $BSAE$ = Surface area of the body parts exposed to soil (cm^2/day)
- AF = Adherence factor (mg/cm^2)
- $ABSd$ = Dermal absorption factor (unitless)
- FC = Fraction in contact with soil (unitless)
- EF = Exposure frequency (days/year)
- ED = Exposure duration (years)
- CF = Conversion factor (10^{-6} kg/mg)
- BW = Average body weight of the receptor (kg)
- AT = Averaging time of the exposure (years), 78 years for carcinogens and equal to the ED for noncarcinogens

The IF for the inhalation of particulates or volatiles from soil exposure route is calculated with Equation 3:

$$I_{inhalation} = \frac{((ET / 24) * FI * ABS * EF * ED)}{AT * 365days / year} * PEF \text{ or } VF \quad (3)$$

Where:

$I_{inhalation}$ = Inhalation IF (kg-soil / m³-air)

ET = Exposure time (hr/day)

24 hrs = Hours in a day

ABS = Inhalation absorption factor; conservatively assumed to be 1.0 for chemicals (unitless)

FI = Fraction inhaled of daily total (unitless), assumed = 1

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

AT = Averaging time of the exposure (years), 78 years for carcinogens and equal to the ED for noncarcinogens

PEF = Particulate emission factor for non-volatile compounds (kg/m³); receptor-specific

VF = Volatilization factor for volatile compounds (kg/m³); compound-specific

This equation incorporates the latest inhalation guidance available in USEPA's RAGS Part F (USEPA 2009).

3.7 Absorption Factors

Absorption adjustment factors (AAFs) (including relative absorption factors [RAF]) and dermal absorption factors (ABS_d) are important values that assist in determining the amount of COPCs in media that are potentially taken in and assimilated into the body. The AAFs are incorporated into the intake component of the risk equations and are used to account for the following: 1) the proportion of administered oral (nonaqueous) dose that is absorbed through the gastrointestinal tract; 2) the proportion of the administered dermal dose that is absorbed through the skin into the circulatory system; or 3) the proportion of inhaled dose that is absorbed into the lungs. All of these represent the actual absorbed dose. The AAFs for each soil COPC and exposure route are provided in **Table 5-1** and are discussed below.

3.7.1 Oral

Chemicals in an ingested soil matrix are likely to have a lower efficiency of uptake than that noted in the critical animal study used to derive the reference dose (RfD) or unit risk factor (URF). Because toxicity values are based on administered (ingested) dose, an adjustment factor to account for the relative difference in uptake between soil and the form administered in the critical study may be appropriate. This adjustment is variously termed AAF, RAF, or bioavailability factor (BAF). USEPA (2000) (Region 4 Supplement to RAGS) recommends conservatively assuming 100 percent RAF for COPCs unless sufficient documentation exists to justify an adjustment. Therefore, for soil COPC, all AAFs were set to 1 for the HHRA Amendment.

3.7.2 Dermal

The ABS_d for each COPC was obtained from USEPA's *RAGS Part E: Supplemental Guidance for Dermal Risk Assessment* (USEPA 2004). In general, RAGS Part E recommends a default dermal ABS of 0 percent for VOCs and most metals (USEPA 2004). This is due to rapid volatilization of VOCs from

the skin, which is then accounted for through the inhalation pathway, and the high variability of metals absorption based on ionic state and media characteristics.

3.7.3 Inhalation

No additional relative or absolute absorption factor adjustments were applied to the inhalation route. Therefore, the default inhalation AAF is 100 percent, which conservatively assumes that all of a chemical that is inhaled is absorbed into the body.

3.8 Compounds with a Mutagenic Mode of Action

Certain carcinogens are identified as operating via a mutagenic mode of action (MOA). Key data for a mutagenic MOA may be evidence that the carcinogen or metabolite is deoxyribonucleic acid (DNA) reactive and/or has the ability to bind to DNA. These carcinogens also produce gene mutations and structural chromosome aberrations (USEPA 2005a). The USEPA 2005 *Guidelines for Carcinogen Risk Assessment and Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* emphasize using mode of action information in interpreting and quantifying the potential cancer risk to humans (USEPA 2005a,b). Childhood may be a susceptible period and exposures during childhood generally are not equivalent to exposures at other times in life. To evaluate risks from early life exposure, the USEPA *Supplemental Guidance* advises that age-dependent adjustment factors (ADAFs) be used for carcinogenic compounds having a mutagenic mode of action (USEPA 2005b). The equation for adjusting the intake factors for mutagenic COPCs is presented in Equation 4:

$$IF_{mut-n} = IF_n \times ADAF \quad (4)$$

Where:

- IF_{mut-n} = Adjusted Intake Factor for mutagenic COPC_n (mg/kg-day)
- IF_n = Intake Factor for COPC_n (mg/kg-day)
- ADAF = age-dependent adjustment factor (unitless)
 - = 10 for children age 1 to 6 years
 - = 3 for adolescents age 7 to 16 years
 - = 1 for adults greater than 16 years old

On September 28, 2011 USEPA posted the final toxicological evaluation for TCE on the Integrated Risk Information System (IRIS) database. Per the toxicological evaluation, USEPA concluded that TCE is carcinogenic via a mutagenic mode of action for the induction of kidney tumors. TCE has been identified as a COPC. Therefore the intake factors for child receptors have been adjusted by a factor of 10, and intake factors for adolescent receptors have been adjusted by a factor of 3 to account for potential exposure to mutagens in environmental media.

3.9 Exposure Areas and Exposure Point Concentrations

The exposure area is a portion of a site or facility over which a receptor will have equal and random contact with potentially contaminated media. An impacted site or facility may have multiple exposure areas depending on receptor type and complete routes of exposure. Exposure areas are defined based on current and reasonably anticipated future use scenarios and often take into account land use patterns of development in the immediate area, land and resource use regulations, ordinances, restrictions, or covenants, activities, historical and anticipated operations, relevant indications of anticipated land use from the owner of the property and local planning officials, and natural breaks/divides in the topography.

The RA evaluated one exposure area based on the following: the area with exceedances of the screening levels defined in Section 2.2.3 is 1) currently vacant and undeveloped; 2) it is relatively small

in size (standard for a commercial/industrial facility); and 3) extensive remediation has occurred which has removed a number of potential sources of elevated concentrations and replaced impacted material with soils that are more uniformly distributed.

Exposure point concentrations represent the amount of a COPC that a receptor may be exposed to via a particular pathway. Since receptors typically move about freely within portions of a site or facility, exposure potential is best represented by use of average concentrations. In accordance with MDEQ and USEPA guidance, the upper bound 95 percent UCL on the arithmetic mean best describes exposure to the medium (MDEQ 2012c, 2009; USEPA 2002c). The statistical evaluation of the 99 percent UCL was calculated using ProUCL version 4.1.1 (USEPA 2011c), which is a software package developed for USEPA by Lockheed Martin that is generally recommended for calculation of the EPC. The EPCs for surface and subsurface soil COPC are presented in **Table 3-5** and ProUCL outputs are provided in Appendix B.

The UCL calculation for TCE in surface soil has reduced reliability due to the high statistical uncertainty associated with the low number of detected values ($n=6$) and a higher number of non-detected values. It is recommended to have 10 to 15 or more distinct observations (i.e., detections) to have meaningful results. As such, caution should be used when interpreting these results. To partially compensate for this uncertainty, ProUCL recommends the use of the 99% KM Chebyshev UCL and the proposed UCL is considered valid.

4.0 Fate and Transport

In addition to exposure pathways involving direct contact, several exposure pathways involve the transfer of a compound from one medium to another resulting in indirect exposures to potential impacts via secondary, tertiary, and quaternary sources. At BNSF Mission Wye, these exposure pathways involve:

- Transfer of a compound from the subsurface into indoor air (e.g., vapor intrusion);
- Transfer of a compound in groundwater into indoor air during household groundwater use (qualitative evaluation only);
- Transfer of a compound in soil into ambient air; and
- Leaching of a compound in soil into groundwater.

Fate and transport models calculate the concentration of chemicals transported from the media from which data have been collected to other exposure media where monitoring data are not available. The fate and transport models used in the RA to address the pathways listed above are described in the following subsections.

4.1 Vapor Intrusion into Indoor Air

Contamination in a source medium can migrate to other media through volatilization. Compounds in the subsurface can volatilize to soil gas, which, in turn, may be transported into indoor air (through cracks in a building's foundation). Potential exposure to VOCs emanating from soil and groundwater, and subsequently soil gas, to indoor air is considered a potentially complete exposure pathway as volatile compounds are present in subsurface media.

The potential for migration of volatile COPCs from the subsurface into an enclosed space was evaluated in accordance with the Soil Vapor Sampling and Analysis Plan approved by DEQ (AECOM 2012a). The soil vapor monitoring was conducted in accordance with the *Montana Vapor Intrusion Guide* (MDEQ 2011). Although no buildings are currently present on the property, soil vapor monitoring was conducted through the installation of VMPs near areas where soil or groundwater impacts have been observed. Once the VMPs were installed, soil vapor samples were collected and evaluated as part of a "lines of evidence approach" to determine whether vapor intrusion would be a potentially complete exposure pathway for future occupants and could result in unacceptable risks to public health, safety, and welfare. Results of the vapor intrusion evaluation are presented in Section 6.5.

4.2 Ambient Air

Receptors may be exposed to volatiles emanating from surface soil into ambient air via inhalation. The two COPCs determined for soil (PCE and TCE) are considered volatile. Therefore, to evaluate the inhalation of volatiles in ambient air pathway, volatilization factors (VFs) were utilized (Table 5-1). The VFs relate a source concentration (i.e., soil) to the resulting concentration in ambient air. The default soil VFs available from USEPA's RSL Table were used in the RA to address the inhalation of volatiles in ambient air pathway (USEPA 2014b). The VFs are derived in accordance with USEPA's *Supplemental Guidance for Developing Soil Screening Levels* (USEPA 2002b). It's important to note that the inhalation of volatiles in ambient air from surface and subsurface soil is typically considered a potentially complete but insignificant exposure pathway due to migration through the soil column (i.e., adsorption, dispersion, dilution).

The VFs discussed in this section are provided on Table 5-1 and are subsequently incorporated into the intake factor calculations and applied in development of human health risks and calculation of cleanup levels.

4.3 Leaching to Groundwater

The leaching of compounds from impacted soil to underlying groundwater through the infiltration of precipitation represents a potential migration pathway. Groundwater at BNSF Mission Wye is not currently used for any purpose other than monitoring; however, the Harris Stock Well, approximately 1 mile downgradient, is used as a potable water supply. As this leaching process may cause adverse impacts to groundwater, consideration in the RA and subsequent FS is warranted.

The selection process used to determine leaching COPCs was presented in Section 2.2.4 and includes analytes that are present in soil at concentrations greater than default SSLs that are also present in SPLP data at concentrations above DEQ-7 groundwater standards. The following approach has been approved by DEQ in the FS Work Plan (AECOM 2013a) and was used for leaching COPC to further refine the leaching evaluation:

- **Calculation of site-specific leaching cleanup levels.** A site-specific DAF was calculated using USEPA's on-line RSL calculator available at <http://epa-prgs.ornl.gov> (USEPA 2014b). A combination of site-specific and default input parameters were used and the result was a site-specific DAF of 56.48. The site-specific DAF was then multiplied by USEPA's default SSLs to yield a site-specific cleanup level for leaching (USEPA 2014b, 1996b). Model input parameters and the site-specific leaching cleanup levels for the four leaching COPC are presented in **Appendix D**. The calculated leaching cleanup levels for iron, manganese, PCE, and TCE are 19,768 mg/kg, 1,581 mg/kg, 0.13 mg/kg, and 0.10 mg/kg, respectively. Leaching cleanup levels were then compared to soil data on a point-by-point basis to determine where exceedances may be present. This comparison is presented in Section 6.4.
- **Review of background levels for inorganics.** If the concentrations of iron and manganese in individual soil samples fall within the background range determined for the property, then it can be concluded potential leaching to groundwater is due to naturally occurring conditions and is not site-related. Note, if background levels are higher than the site-specific leaching cleanup levels, background concentrations become the cleanup level. The maximum detected concentration of manganese in soil (399 mg/kg) is slightly above the background value of 360 mg/kg. Concentrations of iron are above background (15,600 mg/kg) in all but one of the sampled locations (SBS-7E).
- **Review of recent soil data.** Soil samples were collected from borings installed for vapor monitoring in July 2013. Samples were analyzed for VOCs following USEPA Method 8260. Vapor monitoring well nests were installed between MW-4 and SS-88d (which have been identified as potential residual source areas) and near monitoring well MW-3 (which has had the highest concentrations of TCE and PCE in groundwater greater than DEQ-7 groundwater human health standards for TCE and PCE). Results from 2013 soil samples collected from the VMPs were reviewed to determine whether potential leaching exceedances are co-located in soil, SPLP, and vapor monitoring samples. All SPLP results for TCE and PCE in soil samples were below the detection limit of 50 µg/L, but the detection limit is greater than the DEQ-7 standards.
- **Review whether downgradient groundwater wells contain the leaching COPC.** Leaching cleanup level exceedances were evaluated on a point-by-point basis to determine whether COPCs occur in groundwater wells located downgradient from locations where SPLP data were collected at concentrations above the cleanup level. Use of empirical groundwater data to further evaluate the leaching pathway is another line of evidence. The empirical data includes: any impacts from soil have likely reached the groundwater at this time; 36,925 tons of material have been neutralized, excavated and processed with the intent of removing the sources that have contributed to groundwater impacts; and groundwater concentrations are decreasing. Although groundwater concentrations are decreasing, analytical data from groundwater monitoring reports indicate that PCE and TCE have and continue to leach from residually impacted soils to

groundwater at concentrations greater than DEQ-7 standards during high groundwater conditions observed during the summer months. Also, concentrations of manganese and iron in groundwater have remained static at levels below tap-water RSLs although concentrations in soil exceed site-specific background concentrations but are below MDEQ literature background values.

Therefore, if leaching exceedances in currently available analytical soil data exist or evidence of leaching is apparent in SPLP samples, the potential for leaching is assumed to exist. The results of each of the steps to the leaching approach are presented in Section 6.4

5.0 Toxicity Assessment

The purpose of a toxicity assessment is to weigh available evidence regarding the potential for COPCs to cause adverse health effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood or severity of the adverse effect. The toxic effects of a chemical generally depend on the inherent toxicity of the compounds and the level of exposure (dose), as well as on the route of exposure (oral, inhalation, dermal) and the duration of the exposure (subchronic, chronic, lifetime). The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the noncancer effects of the chemical, while the second addresses the cancer effects. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and noncancer effects.

Toxic effects for non-carcinogenic chemicals are based on the RfD. The oral RfD, in units of milligrams per kilogram per day (mg/kg/day), is an estimated daily dose of a chemical where no appreciable risk of chronic effects is expected to occur. Toxic effects for carcinogenic chemicals are based on the cancer slope factor (CSF). The oral CSF, in units of mg/kg/day^{-1} , is used to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular chemical, and assumes that if any dose of a toxic substance increases one's risk for cancer, then every dose can increase the cancer risk in equal proportion. Because of the differing approaches, the risks associated with carcinogenic effects are generally much higher than those associated with the non-carcinogenic effects.

For inhalation exposure, USEPA defines the acceptable concentration for non-carcinogens as the verified reference concentration (RfC) in units of milligrams per cubic meter (mg/m^3). For carcinogens, USEPA defines the acceptable concentration for inhalation exposure as the URF in units of inverse of micrograms per cubic meter ($\mu\text{g/m}^3$)⁻¹. Toxicity data are not available for the dermal route of exposure. Therefore, to evaluate the dermal exposure route, the oral toxicity values were adjusted using gastrointestinal absorption factors (GI_{ABS}) to determine the appropriate dermal toxicity value for use in the HHRA Amendment. Note, the GI_{ABS} is specific to a few select metals and is assumed to be 1 for all other compounds; in which case the dermal toxicity value is assumed to be equal to the oral toxicity value.

The most current toxicity values recommended by the USEPA were used in this HHRA Amendment. Both cancer and non-cancer toxicity values were obtained for those compounds identified as COPCs. The USEPA RSL tables (USEPA 2014b) served as the primary source for toxicity values as the RSL table provided a comprehensive summary of toxicity data and has adopted the preferred hierarchy of sources (USEPA 2003a) including the following.

1. USEPA's IRIS.
2. USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) developed by USEPA Office of Research and Development and National Center for Environmental Assessment. Current PPRTVs are available at <http://hhpprtv.ornl.gov/>.
3. Other toxicity values: Agency for Toxic Substances and Disease Registry minimal risk levels, California Environmental Protection Agency/Office of Environmental Health Hazard Assessment peer reviewed toxicity data, non-discontinued Health Effects Assessment Summary Table (HEAST) values and MDEQ RBCA values for petroleum hydrocarbon fractions (MDEQ 2009).

Toxicity values for direct contact soil COPC are provided in **Table 5-1** and reflect the most current and up-to-date values available at this time.

6.0 Human Health Risk Characterization

Risk characterization integrates the exposure and toxicity assessments to provide the basis for characterizing human health risks. Calculation of risk will provide the information necessary to both determine whether additional data collection is needed and/or if corrective action is warranted or whether institutional controls or other land use restrictions are appropriate. The RA assists in identifying the specific areas where such actions should be targeted.

As presented in the 1993 RRA (RETEC 1993), incremental cancer risks (for known or suspected carcinogens) and HIs (for non-carcinogens) were estimated separately for each exposure scenario and exposure pathway combination. The carcinogenic target risk level is defined as the probability of developing cancer due to an exposure to a COPC. Currently, MDEQ uses an acceptable cumulative carcinogenic risk level of 1×10^{-5} , which corresponds to an increase in risk of 1 out of 100,000 (MDEQ 2009). For non-carcinogenic risk, the cumulative HI must be less than or equal to 1.0 (MDEQ 2009). The 1993 RRA (RETEC 1993) risk estimates were developed in accordance with the procedures presented in RAGS Part A (USEPA 1989).

6.1 Methodology for Characterization of Potential Human Health Risks

The equations used in the development of the risk estimates for soil are summarized below.

6.1.1 Non-carcinogenic Risk

For non-cancer endpoints, protectiveness is measured using the HQ, which is the quotient of the intake factor (i.e., exposure dose) to the protective level (i.e., RfD or RfC), and is calculated with Equation 4 below:

$$HQ = \frac{EPC \times IF}{RfD \text{ or } RfC} \quad (4)$$

Where:

HQ = hazard quotient (unitless)

EPC = exposure point concentration (mg/kg)

IF = intake factor (kg-soil/kg-BW-day and kg/m³ [inhalation pathway])

RfD = reference dose (mg/kg-day)

RfC = reference concentration (mg/m³); inhalation pathway only

An evaluation of potential noncarcinogenic effects based on specific target organ endpoints (e.g., liver effects, neurotoxicity) was performed in accordance with Chapter 8 of USEPA's RAGS Part A (USEPA 1989). The HQ for each individual COPC (for a given receptor) was then summed by target organ to provide a target organ-specific HI, which is an estimate of cumulative non-carcinogenic risk. An HI less than or equal to 1.0 is considered protective of human health. When the HI exceeds unity (i.e., 1) for any receptor, the potential for adverse health effects may not be able to be ruled out.

6.1.2 Carcinogenic Risk

For the cancer endpoint, protectiveness is measured using carcinogenic risk (R), which is the product of the estimated intake factor (i.e., dose) and the CSF or, in the case of the inhalation pathway, the URF, and is calculated with equation 5 below:

$$R = EPC \times IF \times (CSF \text{ or } URF) \times CF \quad (5)$$

Where:

R = cancer risk (unitless)

EPC = exposure point concentration (mg/kg)

IF = intake factor (kg-soil/kg-BW-day and kg/m³ [inhalation pathway])

CSF = cancer slope factor (mg/kg-day)⁻¹

URF = unit risk factor (µg/m³)⁻¹; inhalation pathway only

CF = conversion factor (1,000 µg/mg³); inhalation pathway only

Cumulative cancer risk estimates were determined by summation of the individual COPC risks for a given receptor over all exposure pathways.

6.2 Risk Evaluation for Soil

The risk evaluation for each receptor potentially exposed to surface and/or subsurface soil is discussed below. Exceedances of acceptable risk levels (i.e., a noncancer HI of 1.0 or cancer risk greater than 1x10⁻⁵) are illustrated on **Figure 6-1**.

6.2.1 Future Commercial/Industrial Worker

Table 6-1 presents the risk estimates for the future commercial/industrial worker exposed to surface soil (0 to 2 feet bgs). As indicated, the calculated cancer risk is below the acceptable TRL of 1x10⁻⁵ (risk level = 4.6x10⁻⁶).

For non-carcinogens, the calculated risk from potential exposure to surface soil COPC is above the acceptable HI of 1.0 (HI = 1.6). These results indicate that exposure to COPCs in surface soil may pose unacceptable risk to future commercial/industrial workers. Noncancer risk is due primarily to elevated concentrations of TCE (88 percent of the total risk) at one sample location (SS-88d 2 feet bgs) collected in September of 2007. Removal of impacted surface soil at this location and other areas of remaining impacts would lower the cumulative non-cancer risk to 0.002; which is well below the acceptable HI of 1.

6.2.2 Future Construction/Excavation Worker

As shown on **Table 6-2**, the calculated cancer risk for construction/excavation workers is 1.5x10⁻⁷ and 7.9x10⁻⁸ from potential exposure to surface and subsurface soil, respectively. The risk estimates for both soil intervals are below the TRL of 1x10⁻⁵.

For non-carcinogens, the calculated risk from potential exposure to COPC in surface soil slightly exceeds the acceptable HI of 1.0 (HI=1.2), and as discussed above is due to elevated concentrations of TCE in sample SS-88d. Removal (e.g., excavation) of impacted surface soil at this sample location would also be protective of future construction workers. For subsurface soil, the calculated noncancer risk is 0.6 and is below the acceptable HI of 1.

6.2.3 Current and Future Visitor/Trespasser, Adolescent

As shown on **Table 6-3**, the calculated cancer risk for adolescent visitors/trespassers potentially exposed to surface soil COPC is 1.0x10⁻⁶. This risk estimate is below the TRL of 1x10⁻⁵.

For non-carcinogens, the calculated risk from potential exposure to COPC in surface soil is below the acceptable HI of 1.0 (HI=0.2).

These results indicate potential exposure to surface soil COPC does not pose unacceptable risk to current or future visitors or trespassers and no further evaluation is warranted.

6.2.4 Future Resident, Adult and Child

As shown on **Table 6-4**, the calculated cancer risk for hypothetical future adult and child residents potentially exposed to surface soil COPC is 2.0×10^{-5} and 5.2×10^{-5} , respectively. These risk estimates are above the TRL of 1×10^{-5} .

For non-carcinogens, the calculated risk from potential exposure to COPC in surface soil is also above the acceptable HI of 1.0 at 6.8 and 7.7 for adult and child residents, respectively.

These results indicate potential exposure to surface soil COPC may pose unacceptable risk to future residents and further consideration in the FS is warranted.

As previously discussed, elevated concentrations of PCE and TCE at surface soil sample SS-88d drive the risk and soil removal at this this location and other areas of remaining impacts would lower both the cancer and non-cancer risk to below acceptable levels for residents (i.e., HI = 0.01 and cancer risk level = 2.6×10^{-8} and 6.7×10^{-8} for adult and child residents, respectively).

6.3 Risk Evaluation for Groundwater

As requested by MDEQ, groundwater concentrations were compared directly to DEQ-7 standards to determine whether future use could potentially pose unacceptable risks to receptors in contact with groundwater. As shown on **Table 6-5**, four wells (MW-3, MW-4, MW-9, and MW-22) have reported concentrations of groundwater COPCs above DEQ-7 standards between July 2010 and July 2013.

TCE concentrations exceed the DEQ-7 standard in only one well (MW-3) and concentrations appear to be decreasing with time. The most recent result in MW-3 is only slightly above the DEQ-7 standard of 5 micrograms per liter ($\mu\text{g/L}$) at 5.3 $\mu\text{g/L}$. Concentrations of PCE at MW-22 are also decreasing with time and were only slightly above the DEQ-7 standard of 5 $\mu\text{g/L}$ in the most recent July 2013 monitoring event. Exceedances of DEQ-7 standards at MW-4 for PCE occurred during the 2012 monitoring event but were below in 2013. Similarly, the PCE exceedances at MW-9 occurred in 2011 but have been below DEQ-7 standards in more recent monitoring events. Concentrations of PCE at MW-3 are consistently elevated above DEQ-7 standards and appear unstable with spikes seen during the 2011 and 2013 monitoring events (groundwater elevations were also higher in 2011 and 2013 than in surrounding years).

The exceedances of DEQ-7 standards reported for COPC in groundwater are illustrated on **Figure 6-2**. Overall, these results indicate that future use of groundwater as a drinking water source may pose unacceptable risk to receptors due to concentrations of PCE and TCE. Concentrations of the two additional analytes determined to be leaching COPC (iron and manganese) have remained static at levels below tap-water RSLs and do not pose an unacceptable risk to potential future users.

6.4 Leaching Evaluation

Four analytes in soil were determined to be leaching COPC through comparison of concentrations to default SSLs, review of SPLP data, and evaluation of groundwater data (iron, manganese, PCE and TCE). The potential for these COPCs to leach to groundwater is evaluated further using the steps outlined in Section 4.3. The following paragraphs present the outcome of the refined leaching approach.

As shown on **Table 6-6**, twelve soil locations were found to have concentrations of leaching COPC above site-specific cleanup levels considered protective of groundwater. Concentrations of manganese were below the leaching cleanup level (1,581 mg/kg) but iron concentrations exceeded the leaching cleanup level of 19,768 mg/kg in soil samples SBS-2 and SBS-7. While dissolved iron has been detected

in downgradient groundwater wells, it was present at low levels and was below groundwater screening criteria (i.e., not a groundwater COPC). Additionally, the iron exceedances in soil (maximum concentration was 22,400 mg/kg) were not greatly above the site-specific background level of (15,600 mg/kg). Because the site-specific background data set is limited (i.e., one sample collected in 1993), other state-specific data was reviewed. The maximum concentration also did not exceed Montana's inorganic background concentration of 24,400 mg/kg for iron, and was below the range detected in Park County of 22,900 to 24,600 mg/kg (MDEQ 2013b). Therefore, further consideration of iron and manganese as leaching COPCs is not warranted.

TCE exceeded the leaching cleanup level of 0.10 mg/kg in five locations and has been reported downgradient of soil samples SAB-2 and SBS-7 in monitoring wells MW-4 and MW-5 (the wells present in close proximity [i.e., 100 feet downgradient]). Results from SPLP data collected from VMP-1D (near SS-88 and SS-88d) were non-detect for TCE; however, reporting limits were elevated due to the limited sample volume received at the laboratory. The soil results for TCE at VMP-1D were also non-detect and the reporting limits of 0.05 mg/kg were below the cleanup level and appear adequate to determine if an analyte is present because the sample was not highly diluted. However, concentrations of TCE in groundwater at well MW-3 during the July 2013 sampling event exceeded the DEQ-7 groundwater standard. This, in conjunction the inconclusive SPLP results due to elevated RLs, is an indication that low-level leaching of TCE from a residual soil source to groundwater may be occurring.

PCE exceeded the leaching cleanup level of 0.13 mg/kg in 9 soil locations and has either been detected in nearby (defined as 100 feet) downgradient wells (i.e., MW-4 and 5) or a well was not present in close enough proximity to make an assessment (i.e. near the cell bottoms or in the area along the western property boundary). However, PCE exceedances of DEQ-7 standards in groundwater have only occurred in monitoring wells MW-3, MW-4, MW-9, and MW-22 following the source removal activities in 2000. Again, PCE was not detected in the SPLP results, but reporting limits were elevated. The soil results for PCE at VMP-2D were non-detect along with subsurface results at VMP-1D and reporting limits were below the cleanup level of 0.13 mg/kg. PCE was detected in surface soil at VMP-1D; concentrations were not significantly elevated (0.0578 mg/kg) and were below the cleanup level. However, concentrations of PCE in groundwater at wells MW-3 and MW-22 during the July 2013 sampling event were greater than the DEQ-7 groundwater standard and, coupled with the inconclusive SPLP results due to the elevated RLs, provides an indication that low-level leaching of PCE from a residual soil source to groundwater may be occurring.

It is important to note that concentrations of PCE and TCE in soil are not highly elevated with the exception of SS-88d and SBS-7D (the subsurface soil sample collected from the west wall of test pit TP-7 at approximately 2 feet bgs). The PCE and TCE concentrations at the remaining locations were less than ten times the cleanup level. The soil locations exceeding leaching cleanup levels are illustrated on **Figure 6-3**.

Three of the sample locations (SS-146, ASLAB-2, SAB-2) that exceed the cleanup level for leaching to groundwater are located in the north cell, seep area, and north parking lot areas, which were previously excavated as part of the interim remedial action. MW-4 is located downgradient of these sample locations. PCE and TCE concentrations in MW-4 have decreased since the interim remedial action, and since 2009, concentrations have been near or below the DEQ-7 standard. This indicates that PCE and TCE are no longer leaching at concentrations that cause an exceedance of the DEQ-7 standard.

Based on the outcome of this leaching evaluation, leaching of PCE and TCE from soil may potentially pose a threat to underlying groundwater at seven locations (SS-88d/SS-88, SS-83, SS-157, SBS-7D, CC-B, EC-A, EC-C). Additionally, based on a review of the groundwater and soil sampling locations, there may be a potential data gap in the area between SS-88d and MW-10 where groundwater or soil samples have not been collected. The area within which there are no sample results is approximately 225 feet long by 50 feet wide. Based on the concentrations in groundwater at MW-3, the soil gas data,

and the distance between the BNSF-identified "source areas" and MW-3, there is potential for additional leaching-to-groundwater soil impacts between SS-88d and MW-3.

6.5 Vapor Intrusion Risk Evaluation

Volatile COPCs reported in soil vapor above indoor air and/or soil vapor screening levels were evaluated further to provide additional lines of evidence for determining whether these compounds are related to soil and/or groundwater impacts and whether they have the potential to migrate, as vapors, into the indoor air of future overlying buildings, in the event that this area is developed. The additional lines of evidence for the COPCs identified as a result of the screening are discussed below:

- 1,2,4-Trimethylbenzene has not been detected in groundwater or subsurface soil samples. It was detected in two surface soil samples collected in 1997 from the north and northwest property boundary, but only at very low concentrations, greater than two orders of magnitude below the USEPA soil RSLs for a residential exposure pathway. It was not detected in surface soil samples collected closest to the soil vapor monitoring locations. Therefore, 1,2,4-trimethylbenzene is not retained as a COPC for the vapor intrusion pathway.
- PCE and TCE were detected in groundwater samples collected from multiple wells. The maximum detected concentrations of PCE and TCE in groundwater were in MW-3, which is closest to VMP-2. PCE and TCE were also detected in surface soil samples at multiple locations, with the maximum concentrations at SS-88d, which is located close to VMP-1. VMP-1 had the maximum detected soil vapor concentrations. PCE and TCE were not detected in subsurface soil in samples collected from the vapor monitoring points. Based on this evaluation, PCE and TCE are retained as COPCs in this evaluation.

Cis- and trans-1,2-DCE were detected in groundwater samples collected from multiple wells at concentrations less than DEQ-7 standards. The maximum detected concentrations of cis- and trans-1,2-DCE in groundwater were in MW-3, which is closest to VMP-2. The maximum soil vapor concentrations of cis- and trans-1,2-DCE were located at VMP-1. Cis- and trans-1,2-DCE were not detected in soil samples. However, cis-1,2-DCE is not considered an inhalation risk by IRIS and therefore is not considered a COPC for the vapor intrusion pathway. Based on this evaluation, only trans-1,2-DCE is retained as a COPC. Based on the outcome of the lines of evidence evaluation, vapor intrusion may pose unacceptable risk to hypothetical future receptors in the event that buildings are constructed on or adjacent to railroad-owned property. It is important to note that MDEQ does not recommend the use of soil vapor screening levels which are derived by the application of generic attenuation factors to indoor air screening levels. As a result, the comparison of soil vapor results to indoor air screening levels is overly conservative as attenuation between the subsurface and indoor air is not accounted for. Derivation of an appropriate site-specific attenuation factor would reduce the uncertainty associated with the evaluation, but would require additional investigation.

7.0 Uncertainty Analysis

Quantitative evaluation of human health risk is frequently limited by uncertainty (lack of knowledge) regarding data, exposure, toxicity, and risk issues. Although the RA follows a formal scientific approach, making assumptions or estimates based on limited data that are available or incorporation of professional judgment is an inherent part of the RA process. The uncertainty analysis provides a description of the nature of the uncertainties encountered in developing risk estimates and is an integral part of the RA process as defined by USEPA guidance (USEPA 1989). Uncertainties built into the estimation of exposures and, ultimately, risks may act either to increase or decrease the identified risks, depending on the source of uncertainty.

In general, an RA is designed to include conservative assumptions to avoid missing potential risk. Because of these assumptions and estimates, the resulting risk estimates are themselves uncertain; it is important to keep this in mind when interpreting the results of an RA. Common sources of uncertainty include those related to the development of the SCEM, the factors used to develop the risk estimate (e.g., exposure assumptions and toxicity assumptions), and uncertainty in the parameters used to evaluate risk (e.g., data gaps, exposure point estimates). The common uncertainties associated with RA are typically related to the following categories:

- Data quality, including nature and extent of contamination and determining COPCs;
- Toxicity assessment;
- Exposure assessment; including determining exposure areas and EPCs; and
- Risk characterization.

Uncertainties associated with these RA components account for the majority of potential limitations in RA methodology. The uncertainties associated with the general RA process, as well as site-specific uncertainties, are discussed in **Table 7-1**.

An example of a site-specific uncertainty is provided at the request of MDEQ. There may be a potential data gap in the area between soil sample location SS-88d and monitoring well MW-10 where no groundwater or soil sample results are available and where there may be a potential for additional leaching-to-groundwater soil impacts.

8.0 Development of Cleanup Levels

Cleanup levels represent concentrations of a COPC in a particular medium below which concentrations are not expected to result in adverse health effects (USEPA 1991). Typically, cleanup levels have site-specific significance. The end result of the RA provided details about which COPCs in each media contribute to the majority of the risk (i.e., risk drivers). Cleanup levels were developed for risk drivers upon completion of this HHRA Amendment to aid in remedial activities.

Site-specific cleanup levels for soil were calculated and can be used to determine any locations on the property that require further evaluation/corrective action (e.g., concentration exceeds the site-specific cleanup level). In addition, site-specific cleanup levels will focus the corrective action evaluation. For groundwater, DEQ-7 standards were utilized as the cleanup levels. For the leaching pathway, cleanup levels were discussed in Section 4.3. The specific methodologies used to develop soil cleanup levels are presented below and are based on MDEQ and USEPA guidance (MDEQ 2012, 2009; USEPA 2014a, 1991).

8.1 Cleanup Levels for Non-carcinogenic Compounds

The noncancer cleanup level is presented in Equation 6 below.

$$CUL_{nc} = \frac{THI}{\frac{IF_{ing}}{RfD_o} + \frac{IF_{derm}}{RfD_d} + \frac{IF_{inh}}{RfC}} \quad (6)$$

Where:

- CUL_{nc} = cleanup level, noncancer effects (mg/kg)
- THI = target hazard index (unitless) = 1
- IF_{ing} = ingestion intake factor (kg-soil/kg-BW-day)
- RfD_o = oral reference dose (mg/kg-day)
- IF_{derm} = dermal intake factor (kg-soil/kg-BW-day)
- RfD_d = dermal reference dose (mg/kg-day)
- IF_{inh} = inhalation intake factor (kg/m³)
- RfC_{inh} = inhalation reference concentration (mg/m³)

8.2 Cleanup Levels for Carcinogenic Compounds

The carcinogenic cleanup level is presented in Equation 7 below.

$$CUL_c = \frac{TRL}{(IF_{ing} \times CSF_o) + (IF_{derm} \times CSF_d) + (IF_{inh} \times CF \times IUR)} \quad (7)$$

Where:

- CUL_c = cleanup level, cancer effects (mg/kg)
- TRL = target risk level (unitless) = 1×10^{-5}
- IF_{ing} = ingestion intake factor (kg-soil/kg-BW-day)
- CSF_o = oral cancer slope factor ((mg/kg-day)⁻¹)
- IF_{derm} = dermal intake factor (kg-soil/kg-BW-day)
- CSF_d = dermal cancer slope factor ((mg/kg-day)⁻¹)
- IF_{inh} = inhalation intake factor (kg/m³)
- IUR = Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹
- CF = conversion factor (1,000 $\mu\text{g}/\text{mg}$)

8.3 Summary of Cleanup Levels

Pathway specific soil cleanup levels for each receptor are presented in **Appendix C**, while the combined pathway cleanup levels (i.e., sum of all pathways) are presented in **Table 8-1**. Note, for COPC where both noncancer and cancer endpoints are present, the lowest value was selected as the cleanup level for comparison to data. As shown on **Table 8-1**, the direct contact soil cleanup levels for the residents are the most conservative, followed by the commercial/industrial worker, construction worker and visitor/trespasser. Therefore, the residential cleanup levels would be considered protective of all potential future receptors and are the proposed cleanup levels.

Cleanup levels can be compared to data on a point-by point basis or through use of area-wide average concentrations. However, comparison of data on a point-by-point basis is overly conservative as it assumes a worst case scenario that all exposure occurs at a single location, when in fact receptors move freely around within exposure areas where their exposure is random. Therefore, as indicated in the HHRA Amendment results, not every sample that exceeds a cleanup level would need to be remediated. Removal of a few samples containing elevated concentrations of risk drivers (i.e., hot spots) is sufficient to lower the risk on an area-wide basis to acceptable levels. Select soil samples containing concentrations exceeding the corresponding cleanup levels could be addressed through soil excavation. The cleanup levels can then be compared to confirmation samples to verify that remediation has achieved acceptable risk levels.

The proposed cleanup levels for groundwater and the leaching pathway are also presented on **Table 8-1**. It is important to note that the leaching values are lower than the soil cleanup levels derived for direct contact.

9.0 Summary and Conclusions

The RA described the process used to determine the potential human health risk to receptors associated with exposure to COPCs found in soil and groundwater. The risk to these receptors was calculated in accordance with the MDEQ and USEPA guidance and was designed to be protective of specific receptors and different exposure pathways based on the knowledge of current and anticipated future land use. As the property is currently vacant and future land use is unknown, the receptors evaluated in the risk assessment included commercial/industrial workers, construction workers, adolescent visitors/trespassers, and adult and child residents.

This HHRA Amendment calculated risk for receptors and used the MDEQ-approved cancer TRL of 1×10^{-5} and a non-carcinogenic HI of 1.0 to identify primary areas where COPCs in soil exceed these levels. In addition, the groundwater concentrations were compared to DEQ-7 standards and the potential for chemicals in soil to leach to underlying groundwater was considered in this HHRA Amendment. The results and conclusions are summarized as follows:

- **Soil.** Unacceptable cancer risk was reported for possible future adult and child residents due to potential exposure to surface soil (0-2 feet bgs). Noncancer risk for the commercial/industrial worker, construction/excavation worker and residents is above the acceptable HI of 1 for surface soil and may pose unacceptable risk to these receptors. No risk exists to future adolescent visitors/trespassers or construction/excavation workers from exposure to surface and subsurface soil, respectively.

The surface soil risk is driven by elevated concentrations of PCE, and to a lesser extent TCE, at sample location SS-88d.

- **Groundwater.** Four wells (MW-3, MW-4, MW-9, and MW-22) had reported concentrations of groundwater COPCs above DEQ-7 standards during the four-year period evaluated in this HHRA Amendment (2010 through 2013). COC compounds, PCE and TCE, exceeded the DEQ-7 standards in these wells. Concentrations appear to be decreasing with time; however, the magnitude of the concentration may also be related to variations in the seasonally high groundwater elevation. For example, concentrations of PCE at MW-3 are consistently elevated above DEQ-7 standards during high groundwater (during the summer months) and appear unstable with spikes seen during the 2011 and 2013 monitoring events (groundwater elevations were also higher in 2011 and 2013 than in surrounding years).

While concentrations of PCE and TCE appear to be decreasing with time, these results indicate that future use of groundwater for domestic purposes may pose unacceptable risk to receptors. BNSF may propose institutional controls limiting development on railroad property in the future.

- **Leaching.** Three of the four leaching COPC exceed site-specific cleanup levels at 12 locations. Concentrations of manganese were below leaching cleanup levels, while concentrations of iron were primarily within the background range, not present in groundwater above screening levels, and is a MNA parameter. Therefore, further consideration of iron and manganese is not warranted. PCE and TCE exceed SSLs in soil, were detected in groundwater above DEQ-7 standards and SPLP results contained elevated reporting limits. While leaching is limited at the majority of the soil sampling locations identified due to low level concentrations or non-detects with adequate reporting limits, since impacts have been identified in groundwater, leaching cannot be entirely ruled out at this time. The leaching cleanup level was exceeded at sample locations SS-88d, SBS-7D, SS-83, CC-B, SS-157, EC-A, and EC-C and leaching of PCE and TCE from soil at these locations may potentially pose a threat to underlying groundwater. Specifically, there are two locations (SS-88d and SBS-7D) where the concentrations are greater than ten times the cleanup level. Additionally, no soil samples have been collected between SS-88d and MW-10 and there is potential for additional leaching-to-groundwater soil impacts

between these locations. Collection of additional data in this area could be used to eliminate the potential data gap that contributes to site-specific uncertainty identified in Chapter 7.0.

- **Vapor Intrusion.** The results of the vapor intrusion evaluation indicated that concentrations of cis-1,2-DCE, trans-1,2-DCE, TCE, and PCE in soil and/or groundwater have the potential to migrate, as vapors, into the indoor air of hypothetical future buildings overlying the railroad-owned or adjacent property, in the event that this area is developed. However, cis-1,2-DCE was not retained as a COPC because it is not considered an inhalation risk by IRIS. Trans-1,2-DCE is retained as a COPC. Currently, there is no vapor intrusion pathway since there are no buildings present. However, in the event of future development, a potentially complete vapor intrusion pathway may exist.
- **Ecological.** No potential risk exists to ecological receptors and no further evaluation is warranted.

Overall, the results of this HHRA Amendment indicate that concentration of COPC in soil and groundwater (primarily PCE and TCE) at limited locations may pose unacceptable risk to future receptors.

10.0 References

- AECOM. 2013a. Feasibility Study Work Plan for the BNSF Mission Wye Facility – Revision 4. Mission Wye, Montana. April 4, 2013.
- _____. 2013b. Soil Vapor Monitoring and Vapor Intrusion Evaluation Report. Mission Wye, Montana. November 2013.
- _____. 2012. *July 2012 Groundwater Monitoring Report*. Report prepared for BNSF Railway Company. October.
- ENSR. 2007. *Surface and Subsurface Soil Sampling Plan, Mission Wye, Montana*. Report prepared for BNSF. August. (Attachment 1 to August 6, 2007 letter to MDEQ).
- Montana Department of Environmental Quality (MDEQ). 2013a. Letter to BNSF. RE: Approval of the Final Feasibility Study Work Plan for the BN Mission Wye Facility in Livingston, Montana. April 11, 2013.
- _____. 2013b. Project Report. Background Concentrations of Inorganic Constituents in Montana Surface Soils. Prepared for Montana Department of Environmental Quality by Hydrometrics, Inc. September 2013.
- _____. 2012a. Letter to BNSF. RE: Additional Work Request: Exceedances of Screening/Cleanup Levels at the Mission Wye Comprehensive Environmental Cleanup and Responsibility Act Facility. April 30, 2012.
- _____. 2012c. Frequently Asked Questions (FAQs). Internet website: <http://deq.mt.gov/StateSuperfund/frequentlyaskedquestions.mcp>
- _____. 2012d. Circular DEQ-7 Montana Numeric Water Quality Standards. October 2012.
- _____. 2011. Montana Vapor Intrusion Guide. April 22, 2011.
- _____. 2009. Montana Tier 1 Risk Based Corrective Action Guidance for Petroleum Releases. September 2009.
- _____. 2005. Action Levels for Arsenic In Surface Soil. Remediation Division. April 2005.
- _____. 2000. *Interim Action Memorandum Addendum, Mission Wye, Montana*. Report prepared for BNSF. February.
- _____. 1995. *Interim Action Memorandum, BNRR Mission Wye CECRA Site*. December.
- RETEC. 1993. Revised Risk Assessment. Mission Wye, Montana. Prepared for Burlington Northern Railroad. Prepared by Remediation Technologies, Inc. RETEC Project No. 86-053-854. March.
- _____. 1992. *Phase 1 Remedial Investigation Report, Mission Wye, Montana*. Report prepared for BNRR. Revised July.
- Shacklette, H. S., and J. G. Boerngen. 1984. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional paper 1270:

An account of the concentrations of 50 chemical elements in samples of soils and other regoliths. July 1984.

- United States District Court for the District of Montana (D. Mont.). 1990. Modified Partial Consent Decree, Order, and Judgment (Case No. 88-141-H-CCL), U.S. District Court. April 27, 1990.
- United States Environmental Protection Agency (USEPA). 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6, 2014.
- _____. 2014b. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. May 2014. Internet website: <http://www.epa.gov/region9/superfund/prg/index.html>.
- _____. 2013. OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level (VISL) Calculator, Version 3.1, June 2013.
- _____. 2011a. Exposure Factors Handbook, 2011 Edition. Office of Research and Development. United States Environmental Protection Agency, Washington, D.C. EPA/600/R-90/052F. September 2011.
- _____. 2011b. Highlights of the Exposure Factors Handbook. Office of Research and Development. United States Environmental Protection Agency, Washington, D.C. EPA/600/R-10/030. October 2011.
- _____. 2011c. ProUCL Statistical Software: Version 4.1.00. Technical Support Center for Monitoring and Site Characterization. National Exposure Research Lab, EPA, Las Vegas, Nevada. Software available on the internet website: <http://www.epa.gov/nerlesd1/tsc/software.htm>. February 28.
- _____. 2009. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency. Final. January 2009.
- _____. 2005a. *Guidelines for Carcinogen Risk Assessment*. Risk Assessment Forum. EPA/630/P-03/001F. March.
- _____. 2005b. *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens*. Risk Assessment Forum. EPA/630/R-03/003F. March.
- _____. 2004. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Final July 2004.
- _____. 2003a. *Memorandum for Revised Hierarchy in Human Health Toxicity Values for Superfund Risk Assessments*. OSWER Directive 9285.7-53. December 5, 2003.
- _____. 2003b. RCRA Corrective Action Ecological Screening Levels (ESLs). U.S EPA, Region 5. August 22, 2003. (Soil ESL)
- _____. 2002a. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*. Office of Emergency and Remedial Response. EPA 540-R-01-003. September 2002.

- _____. 2002b. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. OSWER 9355.4-24. December.
- _____. 2002c. Calculating the Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response. OSWER 9285.6-10. December 2002.
- _____. 2000. *Supplemental Guidance to Risk Assessment Guidance for Superfund (RAGS): Region 4 Bulletins, Human Health Risk Assessment Bulletins*. EPA Region 4, originally published November 1995. Internet website: <http://www.epa.gov/region4/waste/oftecser/healthbul>. Updated May 2000.
- _____. 1996a. Soil Screening Guidance: User's Guide. Office of Solid Waste and Emergency Response: Publication 9355: 4-23. United States Environmental Protection Agency.
- _____. 1996b. Soil Screening Guidance: Technical Background Document. (Part 5) EPA/540/R-95/128 Office of Solid Waste and Emergency Response: United States Environmental Protection Agency. May 1996.
- _____. 1994. *Region 8, Superfund Technical Guidance. Evaluating and Identifying Contaminants of Concern for Human Health*. United States Environmental Protection Agency, Hazardous Waste Management Division, Superfund Management Branch, Technical Section. September 1994.
- _____. 1991. Risk Assessment Guidance for Superfund, Volume I— Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). EPA/540/R-92/003. Washington D.C.: United States Environmental Protection Agency, Office of Emergency and Remedial Response. December 1991.
- _____. 1989. Risk Assessment Guidance for Superfund, Volume 1—Human Health Evaluation Manual (Part A). EPA/540/1-89/002. Washington D.C.: United States Environmental Protection Agency, Office of Emergency and Remedial Response. December 1989.

Tables

**Table 2-1 Summary of Soil Background Values
BNSF Mission Wye, Livingston, Montana**

Analyte*	Site-Specific Background Values			Reference	MDEQ Literature Background Values (mg/kg)	Reference
	TP-BKG (surface) (mg/kg)	TP-BKG (vadose) (mg/kg)	TP-BKG (saturated) (mg/kg)			
Antimony	< 5	< 5	< 5	1	0.4	2
Arsenic	< 10	< 10	< 10	1	22.5	2
Barium	270	130	88	1	429	2
Cadmium	< 1	< 1	< 1	1	0.7	2
Chromium	14	20	18	1	41.7	2
Copper	18	10	10	1	165	2
Iron	15,600	13,100	11,500	1	24,400	2
Lead	19	<10	<10	1	29.8	2
Manganese	360	180	140	1	880	2
Mercury	1	1	< 1	1	NC	2
Molybdenum	< 5	< 5	< 5	1	NA	
Selenium	< 10	< 10	< 10	1	0.7	2
Silver	< 5	< 5	< 5	1	0.3	2
Zinc	66	33	31	1	118	2

Notes:

* Although TP-BKG was also analyzed for organics, all organic data were non-detect.

< = not detected; value shown is the reporting limit.

mg/kg = milligrams per kilogram.

NA = not available.

NC = not calculated. Mercury was analyzed in bulk samples only; all values were <0.05 mg/kg with the exception of one detected concentration reported at 0.068 mg/kg.

Reference:

- 1) RETEC. 1993. *Revised Risk Assessment*, completed by Remediation Technologies, Inc. (RETEC) for Burlington Northern Railroad, Mission Wye, Montana. Appendix A. March 1993.
- 2) MDEQ. 2013. Background Concentrations of Inorganic Constituents in Montana Surface Soils. Table 4-4. September 2013.

**Table 2-2 Human Health Screening Levels for Soil
BNSF Mission Wye, Livingston, Montana**

Soil Analyte	CAS Number	Residential Screening Level (mg/kg)	Reference	Industrial Screening Level (mg/kg)	Reference	Construction Screening Level (mg/kg)	Reference	Leaching Screening Level (mg/kg)	Reference
Organics									
1,1,1,2-Tetrachloroethane	630-20-6	2	2	8.8	2	8.8	2	0.0022	2[b]
1,1,1-Trichloroethane	71-55-6	810	2	3600	2	3600	2	0.7	2[a]
1,1,2,2-Tetrachloroethane	79-34-5	0.6	2	2.7	2	2.7	2	0.0003	2[b]
1,1,2-Trichloroethane	79-00-5	0.15	2	0.63	2	0.63	2	0.016	2[a]
1,1-Dichloroethane	75-34-3	3.6	2	16	2	16	2	0.0078	2[b]
1,1-Dichloroethene	75-35-4	23	2	100	2	100	2	0.025	2[a]
1,1-Dichloropropene	563-58-6	--		--		--		--	
1,2,3-Trichlorobenzene	87-61-6	4.9	2	66	2	66	2	0.021	2[b]
1,2,3-Trichloropropane	96-18-4	0.0051	2	0.11	2	0.11	2	0.000032	2[b]
1,2,4-Trichlorobenzene	120-82-1	5.8	2	26	2	26	2	2	2[a]
1,2,4-Trimethylbenzene	95-63-6	5.8	2	24	2	24	2	0.021	2[b]
1,2-Dibromo-3-chloropropane	96-12-8	0.0053	2	0.064	2	0.064	2	0.00086	2[a]
1,2-Dibromoethane	106-93-4	0.036	2	0.16	2	0.16	2	0.00002	1
1,2-Dichlorobenzene	95-50-1	180	2	930	2	930	2	5.8	2[a]
1,2-Dichloroethane	107-06-2	0.46	2	2	2	2	2	0.01	1
1,2-Dichloropropane	78-87-5	1	2	4.4	2	4.4	2	0.017	2[a]
1,3,5-Trimethylbenzene	108-67-8	78	2	1200	2	1200	2	0.17	2[b]
1,3-Dichlorobenzene	541-73-1	--	1	--	1	--	1	--	
1,3-Dichloropropane	142-28-9	160	2	2300	2	2300	2	0.13	2[b]
1,4-Dichlorobenzene	106-46-7	2.6	2	11	2	11	2	0.72	2[a]
1-Chlorohexane	544-10-5	--		--		--		--	
2,2-Dichloropropane	594-20-7	--		--		--		--	
2-Butanone	78-93-3	2700	2	19000	2	19000	2	1.2	2[b]
2-Chlorotoluene	95-49-8	160	2	2300	2	2300	2	0.23	2[b]
2-Hexanone	591-78-6	20	2	130	2	130	2	0.0088	2[b]
4-Chlorotoluene	106-43-4	160	2	2300	2	2300	2	0.24	2[b]
4-Methyl-2-pentanone	108-10-1	530	2	5600	2	5600	2	0.28	2[b]
Acetone	67-64-1	6100	2	67000	2	67000	2	2.9	2[b]
Benzene	71-43-2	1.2	1	6	1	243	1	0.0379	1
Bromobenzene	108-86-1	29	2	180	2	180	2	0.042	2[b]
Bromochloromethane	74-97-5	15	2	63	2	63	2	0.021	2[b]
Bromodichloromethane	75-27-4	0.29	2	1.3	2	1.3	2	0.22	2[a]
Bromoform	75-25-2	67	2	290	2	290	2	0.21	2[a]
Bromomethane	74-83-9	0.68	2	3	2	3	2	0.0019	2[b]
C11-C22 Aromatics	C11-C22 Aro	548	1	3,757	1	4181	1	380	1
C19-C36 Aliphatics	C19-C36 Alip	15,276	1	153,916	1	130,081	1	NA - immobile	1
C5-C8 Aliphatics	C5-C8 Alip	57	1	301	1	534	1	223	1
C9-C10 Aromatics	C9-C10 Aro	122	1	891	1	1171	1	136	1
C9-C12 Aliphatics	C9-C12 Alip	144	1	713	1	1274	1	11500	1
C9-C18 Aliphatics	C9-C18 Alip	216	1	1,169	1	1947	1	51700	1
Carbon disulfide	75-15-0	77	2	350	2	350	2	0.24	2[b]
Chloroethane	75-00-3	1400	2	5700	2	5700	2	5.9	2[b]
Chloroform	67-66-3	0.32	2	1.4	2	1.4	2	0.22	2[a]
Chloromethane	74-87-3	11	2	46	2	46	2	0.049	2[b]
cis-1,2-Dichloroethene (DCE)	156-59-2	16	2	230	2	230	2	0.21	2[a]
cis-1,3-Dichloropropene*	10061-01-5	1.8	2	8.2	2	8.2	2	0.0017	2[b]
Dibromochloromethane	124-48-1	0.73	2	3.2	2	3.2	2	0.21	2[a]
Dibromomethane	74-95-3	2.3	2	9.8	2	9.8	2	0.002	2[b]
Dichlorodifluoromethane	75-71-8	8.7	2	37	2	37	2	0.3	2[b]
Ethylbenzene	100-41-4	6	1	30	1	1226	1	13.3	1
Extractable Petroleum Hydrocarbons (EPH)*	EPH	200	1	200	1	200	1	--	
Hexachlorobutadiene	87-68-3	6.2	2	30	2	30	2	0.0057	2[b]
Isopropylbenzene	98-82-8	190	2	990	2	990	2	0.74	2[b]
m,p-Xylene*	MP-XYL	55	2	240	2	240	2	0.19	2[b]
Methyl tert-butyl ether	1634-04-4	42	1	208	1	8199	1	0.0784	1
Methylene chloride	75-09-2	35	2	320	2	320	2	0.013	2[a]
Naphthalene	91-20-3	4	1	21	1	156	1	9.32	1
n-Butylbenzene	104-51-8	390	2	5800	2	5800	2	3.2	2[b]
n-Hexane	110-54-3	54	2	250	2	250	2	2.3	2[b]
n-Propylbenzene	103-65-1	330	2	2200	2	2200	2	1.2	2[b]
o-Xylene	95-47-6	65	2	280	2	280	2	0.19	2[b]
p-Isopropyltoluene	99-87-6	--		--		--		--	
sec-Butylbenzene	135-98-8	780	2	12000	2	10000	2	5.9	2[b]
Styrene	100-42-5	600	2	3500	2	3500	2	1.1	2[a]
tert-Butylbenzene	98-06-6	780	2	12000	2	10000	2	1.6	2[b]
Tetrachloroethene (PCE)	127-18-4	8.1	2	39	2	39	2	0.023	2[a]
Toluene (methylbenzene)	108-88-3	628	1	5801	1	5073	1	13.9	1
Total VPH (TVPH)	TVPH	--		--		--		--	
trans-1,2-Dichloroethene (DCE)	156-60-5	160	2	2300	2	2300	2	0.29	2[a]
trans-1,3-Dichloropropene*	10061-02-6	1.8	2	8.2	2	8.2	2	0.0017	2[b]
Trichloroethene (TCE)	79-01-6	0.41	2	1.9	2	1.9	2	0.018	2[a]
Trichlorofluoromethane	75-69-4	73	2	310	2	310	2	0.73	2[b]
Vinyl chloride	75-01-4	0.059	2	1.7	2	1.7	2	0.0069	2[a]
Xylenes (total)	1330-20-7	74	1	319	1	625	1	217	1
Inorganics									
Arsenic	7440-38-2	40	3	40	3	40	3	40	3
Barium	7440-39-3	1500	2	22000	2	22000	2	820	2[a]
Cadmium	7440-43-9	7	2	98	2	98	2	3.8	2[a]
Chromium	7440-47-3	12,000	2	180000	2	180000	2	180000	2[a]
Iron	7439-89-6	5500	2	82000	2	82000	2	350	2[b]
Lead	7439-92-1	400	2	800	2	800	2	140	2[a]
Manganese	7439-96-5	180	2	2600	2	2600	2	28	2[b]
Mercury	7439-97-6	0.94	2	4	2	4	2	1	2[a]
Selenium	7782-49-2	39	2	580	2	580	2	2.6	2[a]
Silver	7440-22-4	39	2	580	2	580	2	0.8	2[b]

Notes:

Per Exhibit IV of the 1990 Modified Partial Consent Decree, EPA Regional Screening Levels (RSLs) (originally called Preliminary Remediation Goals) were adjusted to account for a Hazard Quotient of 0.1.

The soil leaching screening level is adjusted to account for a Dilution Attenuation Factor (DAF) of 10 per the consent decree and MDEQ 2009 guidance. Therefore, the USEPA leaching SSLs were multiplied by 10.

mg/kg = milligrams per kilogram.

-- = not available.

* = surrogate used for screening levels; 1,3-dichloropropene was used for cis and trans 1,3-dichloropropene while m-xylene was used for m,p-xylenes.

References:

- 1) MDEQ. 2009. Appendix C - Master Table All Potential Tier 1 RBSLs for Soil, September 2009. Montana Department of Environmental Quality. Available online at: <http://deq.mt.gov/lust/rbca.mcp>
- 2) USEPA. 2014. Regional Screening Level Summary Table. New Tables (TR = 1.0E-06 and HQ=0.1). May 2014 update. Available online at: <http://www.epa.gov/region9/superfund/prg/>
[a] MCL-based
[b] Risk-based
- 3) MDEQ. 2005. Action Level for Arsenic in Surface Soil. Montana Department of Environmental Quality. Remediation Division. April 2005.

**Table 2-3 Human Health Screening Levels for Groundwater
BNSF Mission Wye, Livingston, Montana**

Groundwater Analyte	CAS Number	Groundwater Screening Level (µg/L) [a]	Reference
1,1,1,2-Tetrachloroethane	630-20-6	0.57	3
1,1,1-Trichloroethane	71-55-6	200	1
1,1,2,2-Tetrachloroethane	79-34-5	2	1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	5500	3
1,1,2-Trichloroethane	79-00-5	3	1
1,1-Dichloroethane	75-34-3	2.7	3
1,1-Dichloroethene	75-35-4	7	1
1,1-Dichloropropene	563-58-6	--	
1,2,3-Trichlorobenzene	87-61-6	0.7	3
1,2,3-Trichloropropane	96-18-4	0.00075	3
1,2,4-Trichlorobenzene	120-82-1	70	1
1,2,4-Trimethylbenzene	95-63-6	1.5	3
1,2-Dibromo-3-chloropropane	96-12-8	0.2	1
1,2-Dibromoethane	106-93-4	0.004	1,2 [b]
1,2-Dichlorobenzene	95-50-1	600	1
1,2-Dichloroethane	107-06-2	4	1,2 [b]
1,2-Dichloropropane	78-87-5	5	1
1,3,5-Trimethylbenzene	108-67-8	12	3
1,3-Dichlorobenzene	541-73-1	600	1
1,3-Dichloropropane	142-28-9	37	3
1,3-Dichloropropene	542-75-6	4	1
1,4-Dichlorobenzene	106-46-7	75	1
2,2-Dichloropropane	594-20-7	--	
2-Butanone	78-93-3	560	3
2-Chlorotoluene	95-49-8	24	3
2-Hexanone	591-78-6	3.8	3
4-Chlorotoluene	106-43-4	25	3
4-Isopropyltoluene	99-87-6	--	
4-Methyl-2-pentanone	108-10-1	120	3
Acetone	67-64-1	1400	3
Arsenic	7440-38-2	10	1
Barium	7440-39-3	1,000	1
Benzene	71-43-2	5	1,2 [b]
Bromobenzene	108-86-1	6.2	3
Bromochloromethane	74-97-5	8.3	3
Bromodichloromethane	75-27-4	10	1
Bromoform	75-25-2	80	1
Bromomethane (methyl bromide)	74-83-9	10	1
Carbon tetrachloride	56-23-5	3	1
Chloride	16887-00-6	--	
Chlorobenzene	108-90-7	100	1
Chloroethane	75-00-3	2100	3
Chloroform	67-66-3	70	1
Chloromethane (methyl chloride)	74-87-3	30	1
Chromium	7440-47-3	100	1
cis-1,2-Dichloroethene	156-59-2	70	1
cis-1,3-Dichloropropene	10061-01-5	4	1
Copper	7440-50-8	1,300	1
Dibromochloromethane	124-48-1	4	1
Dibromomethane	74-95-3	0.8	3
Dichlorodifluoromethane	75-71-8	1,000	1
Diisopropyl ether	108-20-3	150	3
Ethane	74-84-0	--	
Ethene	74-85-1	--	
Ethyl tert-butyl ether (ETBE)	637-92-3	--	
Ethylbenzene	100-41-4	700	1,2 [b]
Hexachlorobutadiene	87-68-3	5	1
Iron	7439-89-6	300	[c]
Isopropylbenzene	98-82-8	45	3
Lead	7439-92-1	15	1
m,p-Xylenes	MP-XYL	10,000	1
Manganese	7439-96-5	50	[d]
Methane	74-82-8	--	
Methyl tert-butyl ether	1634-04-4	30	1,2 [b]
Methylene chloride	75-09-2	5	1
Naphthalene	91-20-3	100	1,2 [b]
n-Butylbenzene	104-51-8	100	3
n-Hexane	110-54-3	32	3
Nitrate/Nitrite	NO3NO2	10,000	1
Nitrogen	7727-37-9	--	
n-Propylbenzene	103-65-1	66	3
o-Xylene	95-47-6	10,000	1
Phosphorus	7723-14-0	--	
sec-Butylbenzene	135-98-8	200	3
Selenium	7782-49-2	50	1
Styrene	100-42-5	100	1
Sulfate	14808-79-8	--	
Tert-amyl methyl ether (TAME)	994-05-8	--	
tert-Butyl Alcohol	75-65-0	--	
tert-Butylbenzene	98-06-6	69	3
Tetrachloroethene	127-18-4	5	1
Toluene	108-88-3	1,000	1,2 [b]
trans-1,2-Dichloroethene	156-60-5	100	1
trans-1,3-Dichloropropene	10061-02-6	2	1
Trichloroethene	79-01-6	5	1
Trichlorofluoromethane	75-69-4	10,000	1
Trihalomethanes, total	Cas-000-053	100	1
Vinyl chloride	75-01-4	0.2	1
Xylenes, total	1330-20-7	10,000	1,2 [b]

Notes:

- [a] Per Exhibit IV of the 1990 Modified Partial Consent Decree, USEPA Regional Screening Levels (RSLs) (originally called Preliminary Remediation Goals) were adjusted to account for a Hazard Quotient of 0.1.
- [b] Identical groundwater screening levels were also provided in Montana DEQ's Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases, Table 3 (MDEQ, 2009); therefore, these references were combined into one column.
- [c] Iron's Secondary Maximum Contaminant Level of 300 micrograms per liter is based on aesthetic properties, such as taste, odor, and staining may be considered as guidance to determine the levels that will interfere with the specified uses.
- [d] Manganese's Secondary Maximum Contaminant Level of 50 micrograms per liter which is based on aesthetic properties such as taste, odor, and staining may be considered as guidance to determine the levels that will interfere with the specified uses.

References:

- 1) MDEQ. 2012. Circular DEQ-7, Montana Numeric Water Quality Standards, October. Montana Department of Environmental Quality. Available online at: <http://www.deq.mt.gov/wqinfo/standards/default.mcp>
- 2) MDEQ. 2009. Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases, September. Montana Department of Environmental Quality. Available online at: http://deq.mt.gov/statesuperfund/rbca_guide.mcp
- 3) USEPA. 2014. Regional Screening Level Summary Table. New Tables (TR = 1.0E-06 and HQ=0.1). May 2014 update. Available online at: <http://www.epa.gov/region9/superfund/prg/>

Table 2-4 Occurrence, Distribution and Selection of Compounds of Potential Concern in Surface Soil
BNSF Mission Wye, Livingston, Montana

Analyte	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum of Concentration (mg/kg)	Maximum of Concentration (mg/kg)	Minimum of Reporting Limit (mg/kg)	Maximum of Reporting Limit (mg/kg)	Residential Screening Level (mg/kg)	Residential COPC	Industrial Screening Level (mg/kg)	Industrial COPC
Tetrachloroethene	23	11	47.83	0.0451	204	0.0818	1.14	8.1	COPC-MDC>SL	39	COPC-MDC>SL
Trichloroethene	23	6	26.09	0.0262	76.3	0.0537	57.1	0.41	COPC-MDC>SL	1.9	COPC-MDC>SL
1,1,1,2-Tetrachloroethane	23	0	0.00			0.0537	3.48	2	ND-MRL>SL; discussed in the UA	8.8	Not a COPC-ND and MRL<SL
1,1,1,2,2-Tetrachloroethane	23	0	0.00			0.0537	57.1	0.6	ND-MRL>SL; discussed in the UA	2.7	ND-MRL>SL; discussed in the UA
1,1,2-Trichloroethane	23	0	0.00			0.0537	3.48	0.15	ND-MRL>SL; discussed in the UA	0.63	Not a COPC-ND and MRL<SL
1,2,3-Trichlorobenzene	23	0	0.00			0.0537	57.1	4.9	ND-MRL>SL; discussed in the UA	66	ND-MRL>SL; discussed in the UA
1,2,3-Trichloropropane	23	0	0.00			0.0818	228	0.0051	ND-MRL>SL; discussed in the UA	0.11	ND-MRL>SL; discussed in the UA
1,2,4-Trichlorobenzene	23	0	0.00			0.0537	17.4	5.8	ND-MRL>SL; discussed in the UA	26	Not a COPC-ND and MRL<SL
1,2-Dibromo-3-chloropropane	23	0	0.00			0.215	228	0.0053	ND-MRL>SL; discussed in the UA	0.064	ND-MRL>SL; discussed in the UA
1,2-Dibromoethane	23	0	0.00			0.0537	3.48	0.036	ND-MRL>SL; discussed in the UA	0.16	ND-MRL>SL; discussed in the UA
1,2-Dichloroethane	23	0	0.00			0.0537	3.48	0.46	ND-MRL>SL; discussed in the UA	2	ND-MRL>SL; discussed in the UA
1,2-Dichloropropane	23	0	0.00			0.0537	3.48	1	ND-MRL>SL; discussed in the UA	4.4	Not a COPC-ND and MRL<SL
1,4-Dichlorobenzene	23	0	0.00			0.0537	3.48	2.6	ND-MRL>SL; discussed in the UA	11	Not a COPC-ND and MRL<SL
2-Hexanone	21	0	0.00			0.818	34.8	20	ND-MRL>SL; discussed in the UA	130	Not a COPC-ND and MRL<SL
Benzene	44	0	0.00			0.0215	3.48	1.2	ND-MRL>SL; discussed in the UA	6	Not a COPC-ND and MRL<SL
Bromodichloromethane	23	0	0.00			0.0537	3.48	0.29	ND-MRL>SL; discussed in the UA	1.3	ND-MRL>SL; discussed in the UA
Bromomethane	23	0	0.00			0.0571	3.48	0.68	ND-MRL>SL; discussed in the UA	3	ND-MRL>SL; discussed in the UA
Carbon tetrachloride	23	0	0.00			0.0537	3.48	0.65	ND-MRL>SL; discussed in the UA	2.9	ND-MRL>SL; discussed in the UA
Chloroform	23	0	0.00			0.0537	3.48	0.32	ND-MRL>SL; discussed in the UA	1.4	ND-MRL>SL; discussed in the UA
Chloromethane	23	0	0.00			0.0571	17.4	11	ND-MRL>SL; discussed in the UA	46	Not a COPC-ND and MRL<SL
Dibromochloromethane	23	0	0.00			0.0537	3.48	0.73	ND-MRL>SL; discussed in the UA	3.2	ND-MRL>SL; discussed in the UA
Dibromomethane	23	0	0.00			0.0537	3.48	2.3	ND-MRL>SL; discussed in the UA	9.8	Not a COPC-ND and MRL<SL
Hexachlorobutadiene	23	0	0.00			0.268	285	6.2	ND-MRL>SL; discussed in the UA	30	ND-MRL>SL; discussed in the UA
Naphthalene	44	0	0.00			0.215	228	4	ND-MRL>SL; discussed in the UA	21	ND-MRL>SL; discussed in the UA
trans-1,3-Dichloropropene	23	0	0.00			0.0537	3.48	1.8	ND-MRL>SL; discussed in the UA	8.2	Not a COPC-ND and MRL<SL
Vinyl chloride	23	0	0.00			0.0215	3.48	0.059	ND-MRL>SL; discussed in the UA	1.7	ND-MRL>SL; discussed in the UA
Extractable Petroleum Hydrocarbons, Total	21	20	95.24	6.2	770	67.8	67.8	200	Not a COPC [a]	200	Not a COPC [a]
1,2,4-Trimethylbenzene	23	2	8.70	0.0218	0.0304	0.0537	57.1	5.8	Not a COPC-MDC<SL	24	Not a COPC-MDC<SL
C11-C22 Aromatics	21	19	90.48	3.43	219	22.6	23	548	Not a COPC-MDC<SL	3757	Not a COPC-MDC<SL
C19-C36 Aliphatics	21	19	90.48	9.57	562	20.8	22.6	15276	Not a COPC-MDC<SL	153916	Not a COPC-MDC<SL
C5-C8 Aliphatics	21	1	4.76	30.1	30.1	2.04	2.29	57	Not a COPC-MDC<SL & DF <5%	301	Not a COPC-MDC<SL & DF <5%
C9-C10 Aromatics	21	1	4.76	0.581	0.581	2.04	2.29	122	Not a COPC-MDC<SL & DF <5%	891	Not a COPC-MDC<SL & DF <5%
C9-C18 Aliphatics	21	1	4.76	8.53	8.53	20.4	43.5	216	Not a COPC-MDC<SL & DF <5%	1169	Not a COPC-MDC<SL & DF <5%
Ethylbenzene	44	1	2.27	0.0376	0.0376	0.051	3.48	6	Not a COPC-MDC<SL & DF <5%	30	Not a COPC-MDC<SL & DF <5%
m,p-Xylenes	21	1	4.76	0.0238	0.0238	0.164	6.96	55	Not a COPC-MDC<SL & DF <5%	240	Not a COPC-MDC<SL & DF <5%
Methyl tert-butyl ether	44	1	2.27	0.0226	0.0226	0.051	17.4	42	Not a COPC-MDC<SL & DF <5%	208	Not a COPC-MDC<SL & DF <5%
Methylene chloride	23	1	4.35	0.123	0.123	0.0571	34.8	35	Not a COPC-MDC<SL & DF <5%	320	Not a COPC-MDC<SL & DF <5%
Xylenes, total	44	2	4.55	0.0238	0.0386	0.0571	10.4	74	Not a COPC-MDC<SL & DF <5%	319	Not a COPC-MDC<SL & DF <5%
1,1,1-Trichloroethane	23	0	0.00			0.0537	3.48	810	Not a COPC-ND and MRL<SL	3600	Not a COPC-ND and MRL<SL
1,1-Dichloroethane	23	0	0.00			0.0537	3.48	3.6	Not a COPC-ND and MRL<SL	16	Not a COPC-ND and MRL<SL
1,1-Dichloroethene	23	0	0.00			0.0537	3.48	23	Not a COPC-ND and MRL<SL	100	Not a COPC-ND and MRL<SL
1,2-Dichlorobenzene	23	0	0.00			0.0537	57.1	180	Not a COPC-ND and MRL<SL	930	Not a COPC-ND and MRL<SL
1,3,5-Trimethylbenzene	23	0	0.00			0.0537	3.48	78	Not a COPC-ND and MRL<SL	1200	Not a COPC-ND and MRL<SL
1,3-Dichloropropane	23	0	0.00			0.0537	3.48	160	Not a COPC-ND and MRL<SL	2300	Not a COPC-ND and MRL<SL
2-Butanone	23	0	0.00			0.0571	34.8	2700	Not a COPC-ND and MRL<SL	19000	Not a COPC-ND and MRL<SL
2-Chlorotoluene	23	0	0.00			0.0537	57.1	160	Not a COPC-ND and MRL<SL	2300	Not a COPC-ND and MRL<SL
4-Chlorotoluene	23	0	0.00			0.0537	3.48	160	Not a COPC-ND and MRL<SL	2300	Not a COPC-ND and MRL<SL
4-Methyl-2-pentanone	23	0	0.00			0.0571	34.8	530	Not a COPC-ND and MRL<SL	5600	Not a COPC-ND and MRL<SL
Acetone	23	0	0.00				34.8	6100	Not a COPC-ND and MRL<SL	67000	Not a COPC-ND and MRL<SL
Bromobenzene	23	0	0.00			0.0537	3.48	29	Not a COPC-ND and MRL<SL	180	Not a COPC-ND and MRL<SL
Bromochloromethane	23	0	0.00			0.0537	3.48	15	Not a COPC-ND and MRL<SL	63	Not a COPC-ND and MRL<SL
Bromoform	23	0	0.00			0.0571	3.48	67	Not a COPC-ND and MRL<SL	290	Not a COPC-ND and MRL<SL
C9-C12 Aliphatics	21	0	0.00			2.04	2.34	144	Not a COPC-ND and MRL<SL	713	Not a COPC-ND and MRL<SL
Carbon disulfide	21	0	0.00			0.0818	3.48	77	Not a COPC-ND and MRL<SL	350	Not a COPC-ND and MRL<SL
Chlorobenzene	23	0	0.00			0.0537	3.48	28	Not a COPC-ND and MRL<SL	130	Not a COPC-ND and MRL<SL
Chloroethane	23	0	0.00			0.0571	3.48	1400	Not a COPC-ND and MRL<SL	5700	Not a COPC-ND and MRL<SL
cis-1,2-Dichloroethene	23	0	0.00			0.0537	3.48	16	Not a COPC-ND and MRL<SL	230	Not a COPC-ND and MRL<SL
cis-1,3-Dichloropropene	23	0	0.00			0.0537	3.48	1.8	Not a COPC-ND and MRL<SL	8.2	Not a COPC-ND and MRL<SL
Dichlorodifluoromethane	23	0	0.00			0.0537	3.48	8.7	Not a COPC-ND and MRL<SL	37	Not a COPC-ND and MRL<SL
Isopropylbenzene	23	0	0.00			0.0537	57.1	190	Not a COPC-ND and MRL<SL	990	Not a COPC-ND and MRL<SL
n-Butylbenzene	23	0	0.00			0.0537	3.48	390	Not a COPC-ND and MRL<SL	5800	Not a COPC-ND and MRL<SL
n-Hexane	21	0	0.00			0.409	17.4	54	Not a COPC-ND and MRL<SL	250	Not a COPC-ND and MRL<SL
n-Propylbenzene	23	0	0.00			0.0537	3.48	330	Not a COPC-ND and MRL<SL	2200	Not a COPC-ND and MRL<SL
o-Xylene	21	0	0.00			0.0818	3.48	65	Not a COPC-ND and MRL<SL	280	Not a COPC-ND and MRL<SL
sec-Butylbenzene	23	0	0.00			0.0228	3.48	780	Not a COPC-ND and MRL<SL	12000	Not a COPC-ND and MRL<SL
Styrene	23	0	0.00			0.0537	3.48	600	Not a COPC-ND and MRL<SL	3500	Not a COPC-ND and MRL<SL
tert-Butylbenzene	23	0	0.00			0.0537	57.1	780	Not a COPC-ND and MRL<SL	12000	Not a COPC-ND and MRL<SL
Toluene	44	0	0.00			0.051	3.48	628	Not a COPC-ND and MRL<SL	5801	Not a COPC-ND and MRL<SL
trans-1,2-Dichloroethene	23	0	0.00			0.0537	3.48	160	Not a COPC-ND and MRL<SL	2300	Not a COPC-ND and MRL<SL
Trichlorofluoromethane	23	0	0.00			0.0571	3.48	73	Not a COPC-ND and MRL<SL	310	Not a COPC-ND and MRL<SL
1,1,2-Trichloro-1,2,2-trifluoroethane	2	0	0.00			0.0537	0.228		Not a COPC-SL NA		Not a COPC-SL NA
1,1-Dichloropropene	23	0	0.00			0.0228	3.48		Not a COPC-SL NA		Not a COPC-SL NA
1,3-Dichlorobenzene	23	0	0.00			0.0537	3.48		Not a COPC-SL NA		Not a COPC-SL NA
1-Chlorohexane	21	0	0.00			0.818	34.8		Not a COPC-SL NA		Not a COPC-SL NA
2,2-Dichloropropane	23	0	0.00			0.0818	3.48		Not a COPC-SL NA		Not a COPC-SL NA
4-Isopropyltoluene	23	0	0.00			0.0537	57.1		Not a COPC-SL NA		Not a COPC-SL NA
Allyl chloride	2	0	0.00			0.0571	0.215		Not a COPC-SL NA		Not a COPC-SL NA
C9-C12 Aliphatics, adjusted	21	0	0.00			2.04	2.29		Not a COPC-SL NA		Not a COPC-SL NA
Dichlorofluoromethane	2	0	0.00			0.0571	0.537		Not a COPC-SL NA		Not a COPC-SL NA
Diethyl ether (Ethyl ether)	2	0	0.00			0.215	0.228		Not a COPC-SL NA		Not a COPC-SL NA
Tetrahydrofuran	2	0	0.00			0.228	2.15		Not a COPC-SL NA		Not a COPC-SL NA
C5-C8 Aliphatics, adjusted	21	1	4.76	30	30	2.04	2.29		Not a COPC-SL NA & DF<5%		Not a COPC-SL NA & DF<5%
Volatile Petroleum Hydrocarbons, Total	21	1	4.76	32.5	32.5	4.08	4.59		Not a COPC-SL NA & DF<5%		Not a COPC-SL NA & DF<5%

Notes:
Shading indicates compound of potential concern (COPC).
[a] Although EPH total MDC exceeds residential and industrial SLs, EPH fraction MDCs do not exceed their respective SLs, indicating that EPH is not a concern. Therefore, it is not identified as a COPC and does not require further evaluation.
DF = detection frequency.
mg/kg = milligram per kilogram.
MDC = maximum detected concentration.
MRL = maximum reporting limit.
NA = not available.
ND = not detected.
SL = screening level.
SL NA = screening level not available.
Surface soil defined as 0-2 feet below ground surface.
COPC = compound of potential concern.
UA = uncertainty analysis (Table 7-1 provides a discussion of the uncertainties associated with the risk assessment process).

**Table 2-5 Occurrence, Distribution and Selection of Compounds of Potential Concern in Subsurface Soil
BNSF Mission Wye, Livingston, Montana**

Analyte	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum of Concentration (mg/kg)	Maximum of Concentration (mg/kg)	Minimum of Reporting Limit (mg/kg)	Maximum of Reporting Limit (mg/kg)	Background Level (mg/kg)	Leaching Screening Level (mg/kg)	Leaching COPC	Construction Screening Level (mg/kg)	Construction COPC
1,2-Dichlorobenzene	83	2	2.41	3.8	6.2	0.0502	57.1		5.8	Not a COPC-DF<5% (MDC>SL)	930	Not a COPC-MDC<SL
1,4-Dichlorobenzene	83	2	2.41	0.84	1.3	0.0502	3.48		0.72	Not a COPC-DF<5% (MDC>SL)	11	Not a COPC-MDC<SL
1,2,4-Trimethylbenzene	70	2	2.86	0.0218	0.0304	0.0517	57.1		0.021	Not a COPC-DF<5% (MDC>SL)	24	Not a COPC-MDC<SL
Iron	30	30	100	12,700	22,400			15,600	350	COPC-MDC>SL	82000	Not a COPC-MDC<SL
m,p-Xylenes	74	1	1.35	0.0238	0.0238	0.127	6.96		0.19	Not a COPC-DF<5% (MDC>SL)	240	Not a COPC-MDC<SL
Manganese	30	30	100	202	399			360	28	COPC-MDC>SL	2600	Not a COPC-MDC<SL
Methylene chloride	78	1	1.28	0.123	0.123	0.0517	34.8		0.013	Not a COPC-DF<5% (MDC>SL)	320	Not a COPC-MDC<SL
Tetrachloroethene	83	21	25.30	0.0197	204	0.0502	1.14		0.023	COPC-MDC>SL	39	COPC-MDC>SL
Trichloroethene	83	10	12.05	0.0262	76.3	0.0502	57.1		0.018	COPC-MDC>SL	1.9	COPC-MDC>SL
1,1,1,2-Tetrachloroethane	78	0	0.00			0.0517	3.48		0.0022	ND-MRL>SL; discussed in the UA	8.8	Not a COPC-ND and MRL<SL
1,1,1-Trichloroethane	83	0	0.00			0.0201	3.48		0.7	ND-MRL>SL; discussed in the UA	3600	Not a COPC-ND and MRL<SL
1,1,2,2-Tetrachloroethane	78	0	0.00			0.0502	57.1		0.0003	ND-MRL>SL; discussed in the UA	2.7	ND-MRL>SL; discussed in the UA
1,1,2-Trichloroethane	78	0	0.00			0.0502	3.48		0.016	ND-MRL>SL; discussed in the UA	0.63	ND-MRL>SL; discussed in the UA
1,1-Dichloroethane	83	0	0.00			0.0502	3.48		0.0078	ND-MRL>SL; discussed in the UA	16	Not a COPC-ND and MRL<SL
1,1-Dichloroethane	78	0	0.00			0.0517	3.48		0.025	ND-MRL>SL; discussed in the UA	100	Not a COPC-ND and MRL<SL
1,2,3-Trichlorobenzene	70	0	0.00			0.0537	57.1		0.021	ND-MRL>SL; discussed in the UA	66	ND-MRL>SL; discussed in the UA
1,2,3-Trichloropropane	78	0	0.00			0.0517	228		0.0000032	ND-MRL>SL; discussed in the UA	0.11	ND-MRL>SL; discussed in the UA
1,2,4-Trichlorobenzene	70	0	0.00			0.0502	17.4		2	ND-MRL>SL; discussed in the UA	26	Not a COPC-ND and MRL<SL
1,2-Dibromo-3-chloropropane	70	0	0.00			0.0517	228		0.00086	ND-MRL>SL; discussed in the UA	0.064	ND-MRL>SL; discussed in the UA
1,2-Dibromoethane	78	0	0.00			0.0502	3.48		0.00002	ND-MRL>SL; discussed in the UA	0.16	ND-MRL>SL; discussed in the UA
1,2-Dichloroethane	78	0	0.00			0.0517	3.48		0.01	ND-MRL>SL; discussed in the UA	2	ND-MRL>SL; discussed in the UA
1,2-Dichloropropane	78	0	0.00			0.0537	3.48		0.017	ND-MRL>SL; discussed in the UA	4.4	Not a COPC-ND and MRL<SL
1,3,5-Trimethylbenzene	70	0	0.00			0.0502	3.48		0.17	ND-MRL>SL; discussed in the UA	1200	Not a COPC-ND and MRL<SL
1,3-Dichloropropane	78	0	0.00			0.0502	3.48		0.13	ND-MRL>SL; discussed in the UA	2300	Not a COPC-ND and MRL<SL
2-Butanone	78	0	0.00			0.0517	34.8		1.2	ND-MRL>SL; discussed in the UA	19000	Not a COPC-ND and MRL<SL
2-Chlorotoluene	78	0	0.00			0.0502	57.1		0.23	ND-MRL>SL; discussed in the UA	2300	Not a COPC-ND and MRL<SL
2-Hexanone	66	0	0.00			0.633	34.8		0.0088	ND-MRL>SL; discussed in the UA	130	Not a COPC-ND and MRL<SL
4-Chlorotoluene	78	0	0.00			0.0502	3.48		0.24	ND-MRL>SL; discussed in the UA	2300	Not a COPC-ND and MRL<SL
4-Methyl-2-pentanone	70	0	0.00			0.0502	34.8		0.28	ND-MRL>SL; discussed in the UA	5600	Not a COPC-ND and MRL<SL
Acetone	70	0	0.00			0.0502	34.8		2.9	ND-MRL>SL; discussed in the UA	67000	Not a COPC-ND and MRL<SL
Benzene	99	0	0.00			0.0207	3.48		0.0379	ND-MRL>SL; discussed in the UA	243	Not a COPC-ND and MRL<SL
Bromobenzene	78	0	0.00			0.0502	3.48		0.042	ND-MRL>SL; discussed in the UA	180	Not a COPC-ND and MRL<SL
Bromochloromethane	78	0	0.00			0.0502	3.48		0.021	ND-MRL>SL; discussed in the UA	63	Not a COPC-ND and MRL<SL
Bromodichloromethane	78	0	0.00			0.0502	3.48		0.22	ND-MRL>SL; discussed in the UA	1.3	ND-MRL>SL; discussed in the UA
Bromofluoromethane	78	0	0.00			0.0502	3.48		0.21	ND-MRL>SL; discussed in the UA	290	Not a COPC-ND and MRL<SL
Bromomethane	78	0	0.00			0.0517	3.48		0.0019	ND-MRL>SL; discussed in the UA	3	ND-MRL>SL; discussed in the UA
Carbon disulfide	66	0	0.00			0.0633	3.48		0.24	ND-MRL>SL; discussed in the UA	350	Not a COPC-ND and MRL<SL
Carbon tetrachloride	78	0	0.00			0.0207	3.48		0.019	ND-MRL>SL; discussed in the UA	2.9	ND-MRL>SL; discussed in the UA
Chlorobenzene	83	0	0.00			0.0502	3.48		0.68	ND-MRL>SL; discussed in the UA	130	Not a COPC-ND and MRL<SL
Chloroform	78	0	0.00			0.0502	3.48		0.22	ND-MRL>SL; discussed in the UA	1.4	ND-MRL>SL; discussed in the UA
Chloromethane	78	0	0.00			0.0517	17.4		0.049	ND-MRL>SL; discussed in the UA	46	Not a COPC-ND and MRL<SL
cis-1,3-Dichloropropene	78	0	0.00			0.0502	3.48		0.0017	ND-MRL>SL; discussed in the UA	8.2	Not a COPC-ND and MRL<SL
Dibromochloromethane	78	0	0.00			0.0502	3.48		0.21	ND-MRL>SL; discussed in the UA	3.2	ND-MRL>SL; discussed in the UA
Dibromomethane	78	0	0.00			0.0502	3.48		0.002	ND-MRL>SL; discussed in the UA	9.8	Not a COPC-ND and MRL<SL
Dichlorodifluoromethane	78	0	0.00			0.0502	3.48		0.3	ND-MRL>SL; discussed in the UA	37	Not a COPC-ND and MRL<SL
Hexachlorobutadiene	70	0	0.00			0.0517	285		0.0057	ND-MRL>SL; discussed in the UA	30	ND-MRL>SL; discussed in the UA
Isopropylbenzene	70	0	0.00			0.0517	57.1		0.74	ND-MRL>SL; discussed in the UA	990	Not a COPC-ND and MRL<SL
Naphthalene	91	0	0.00			0.0502	228		9.32	ND-MRL>SL; discussed in the UA	156	ND-MRL>SL; discussed in the UA
o-Xylene	74	0	0.00			0.0633	3.48		0.19	ND-MRL>SL; discussed in the UA	280	Not a COPC-ND and MRL<SL
sec-Butylbenzene	70	0	0.00			0.0228	3.48		5.9	ND-MRL>SL; discussed in the UA	10000	Not a COPC-ND and MRL<SL
Styrene	78	0	0.00			0.0502	3.48		1.1	ND-MRL>SL; discussed in the UA	3500	Not a COPC-ND and MRL<SL
tert-Butylbenzene	70	0	0.00			0.0517	57.1		1.6	ND-MRL>SL; discussed in the UA	10000	Not a COPC-ND and MRL<SL
trans-1,2-Dichloroethene	83	0	0.00			0.0517	3.48		0.29	ND-MRL>SL; discussed in the UA	2300	Not a COPC-ND and MRL<SL
trans-1,3-Dichloropropene	78	0	0.00			0.0517	3.48		0.0017	ND-MRL>SL; discussed in the UA	8.2	Not a COPC-ND and MRL<SL
Vinyl chloride	78	0	0.00			0.0215	3.48		0.0069	ND-MRL>SL; discussed in the UA	1.7	ND-MRL>SL; discussed in the UA
Arsenic	30	30	100	1.66	6.12			22.5	40	Not a COPC-MDC<SL & Bkg	40	Not a COPC-MDC<SL
Barium	30	30	100.00	81.6	358			270	820	Not a COPC-MDC<SL	22000	Not a COPC-MDC<SL
C11-C22 Aromatics	21	19	90.48	3.43	219	22.6	23		380	Not a COPC-MDC<SL	4181	Not a COPC-MDC<SL
Cadmium	30	30	100	0.11	0.499			0.7	3.8	Not a COPC-MDC<SL & Bkg	98	Not a COPC-MDC<SL
Chromium	30	30	100	11.1	38.3			14	1800000	Not a COPC-MDC<SL	180000	Not a COPC-MDC<SL
Lead	30	30	100	4.13	44.4			19	140	Not a COPC-MDC<SL	800	Not a COPC-MDC<SL
Mercury	30	11	36.67	0.00955	0.0466	0.0985	0.138	1	1	Not a COPC-MDC<SL & Bkg	4	Not a COPC-MDC<SL
Selenium	30	30	100	0.241	0.484			0.7	2.6	Not a COPC-MDC<SL & Bkg	580	Not a COPC-MDC<SL
Silver	30	18	60.00	0.0535	0.211	0.44	0.673	0.3	0.8	Not a COPC-MDC<SL & Bkg	580	Not a COPC-MDC<SL
C5-C8 Aliphatics	21	1	4.76	30.1	30.1	2.04	2.29		223	Not a COPC-MDC<SL & DF<5%	534	Not a COPC-MDC<SL
C9-C10 Aromatics	21	1	4.76	0.581	0.581	2.04	2.29		136	Not a COPC-MDC<SL & DF<5%	1171	Not a COPC-MDC<SL
C9-C18 Aliphatics	21	1	4.76	8.53	8.53	20.4	43.5		51700	Not a COPC-MDC<SL & DF<5%	1947	Not a COPC-MDC<SL
cis-1,2-Dichloroethene	83	1	1.20	0.196	0.196	0.0537	3.48		0.21	Not a COPC-MDC<SL & DF<5%	230	Not a COPC-MDC<SL
Ethylbenzene	99	1	1.01	0.0376	0.0376	0.0502	3.48		13.3	Not a COPC-MDC<SL & DF<5%	1226	Not a COPC-MDC<SL
Methyl tert-butyl ether	99	1	1.01	0.0226	0.0226	0.0502	17.4		0.0784	Not a COPC-MDC<SL & DF<5%	8199	Not a COPC-MDC<SL
Toluene	99	1	1.01	0.0176	0.0176	0.051	3.48		13.9	Not a COPC-MDC<SL & DF<5%	5073	Not a COPC-MDC<SL
Xylenes, total	91	2	2.20	0.0238	0.0386	0.0502	10.4		217	Not a COPC-MDC<SL & DF<5%	625	Not a COPC-MDC<SL
C9-C12 Aliphatics	21	0	0.00			2.04	2.34		11500	Not a COPC-ND and MRL<SL	1274	Not a COPC-ND and MRL<SL
Chloroethane	78	0	0.00			0.0502	3.48		5.9	Not a COPC-ND and MRL<SL	5700	Not a COPC-ND and MRL<SL
n-Butylbenzene	70	0	0.00			0.0517	3.48		3.2	ND-MRL>SL; discussed in the UA	5800	Not a COPC-ND and MRL<SL
n-Hexane	66	0	0.00			0.317	17.4		2.3	ND-MRL>SL; discussed in the UA	250	Not a COPC-ND and MRL<SL
n-Propylbenzene	70	0	0.00			0.0502	3.48		1.2	ND-MRL>SL; discussed in the UA	2200	Not a COPC-ND and MRL<SL
Trichlorofluoromethane	78	0	0.00			0.0502	3.48		0.73	ND-MRL>SL; discussed in the UA	310	Not a COPC-ND and MRL<SL
1,1,2-Trichloro-1,2,2-trifluoroethane	4	0	0.00			0.0502	0.259			Not a COPC-SL NA		Not a COPC-SL NA
1,1-Dichloropropene	78	0	0.00			0.0201	3.48			Not a COPC-SL NA		Not a COPC-SL NA
1,3-Dichlorobenzene	78	0	0.00			0.0517	3.48			Not a COPC-SL NA		Not a COPC-SL NA
1-Chlorohexane	66	0	0.00			0.633	34.8			Not a COPC-SL NA		Not a COPC-SL NA
2,2-Dichloropropane	78	0	0.00			0.0502	3.48			Not a COPC-SL NA		Not a COPC-SL NA
2-Chloroethylvinyl ether	8	0	0.00			0.2	0.2			Not a COPC-SL NA		Not a COPC-SL NA
4-Isopropyltoluene	70	0	0.00			0.0517	57.1			Not a COPC-SL NA		Not a COPC-SL NA
Allyl chloride	4	0	0.00			0.0502	2.07			Not a COPC-SL NA		Not a COPC-SL NA
C19-C36 Aliphatics	21	19	90.48	9.57	562	20.8	22.6			Not a COPC-SL NA	130081	Not a COPC-MDC<SL
C9-C12 Aliphatics, adjusted	21	0	0.00			2.04	2.29			Not a COPC-SL NA		Not a COPC-SL NA
Dichlorofluoromethane	4	0	0.00			0.0502	0.537			Not a COPC-SL NA		Not a COPC-SL NA

**Table 2-6 Evaluation of SPLP Data for Further Refinement of Leaching Compounds of Potential Concern
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Number of Samples	Number of Detections	Detetion Frequency (%)	Minimum Detected Concentration (ug/L)	Maximum Detected Concentration (ug/L)	Minimum Reporting Limit (ug/L)	Maximum Reporting Limit (ug/L)	Groundwater Screening Level (ug/L)	COPC Determination
Iron	7439-89-6	4	4	100	909	22,300	50	50	300	COPC - MDC>SL
Manganese	7439-96-5	4	4	100	19.9	513	5	5	50	COPC - MDC>SL
Tetrachloroethene	127-18-4	4	0	0			50	50	5	COPC - ND & MRL>SL
Trichloroethene	79-01-6	4	0	0			50	50	5	COPC - ND & MRL>SL
1,2-Dichlorobenzene	95-50-1	4	0	0			50	50	600	Not a COPC - ND & MRL<SL
1,4-Dichlorobenzene	106-46-7	4	0	0			50	50	75	Not a COPC - ND & MRL<SL

Notes:

Shading indicates compound of potential concern (COPC).

ug/L = micrograms per liter.

MDC = maximum detected concentration.

MRL = maximum reporting limit.

ND = not detected.

SL = screening level.

SPLP = synthetic precipitation leaching procedure.

COPC = compound of potential concern.

Table 2-7 Occurrence, Distribution and Selection of Compounds of Potential Concern in Groundwater
BNSF Mission Wye, Livingston, Montana

Analyte	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum of Concentration (ug/L)	Maximum of Concentration (ug/L)	Minimum of Reporting Limit (ug/L)	Maximum of Reporting Limit (ug/L)	Groundwater Screening Level (ug/L)	COPC Determination
Tetrachloroethene	54	40	74.07	0.22	260	0.1	1	5	COPC-MDC>SL
Trichloroethene	54	48	88.89	0.081	27	0.1	1	5	COPC-MDC>SL
1,1,1,2-Tetrachloroethane	54	0	0.00			0.1	1	0.57	ND-MRL>SL; discussed in the UA
1,2,3-Trichlorobenzene	54	0	0.00			0.4	1	0.7	ND-MRL>SL; discussed in the UA
1,2,3-Trichloropropane	54	0	0.00			0.2	4	0.00075	ND-MRL>SL; discussed in the UA
1,2-Dibromo-3-chloropropane	54	0	0.00			0.4	4	0.2	ND-MRL>SL; discussed in the UA
1,2-Dibromoethane	54	0	0.00			0.1	1	0.004	ND-MRL>SL; discussed in the UA
2-Hexanone	4	0	0.00			5	10	3.8	ND-MRL>SL; discussed in the UA
Dibromomethane	54	0	0.00			0.1	4	0.8	ND-MRL>SL; discussed in the UA
trans-1,3-Dichloropropene	54	0	0.00			0.1	4	2	ND-MRL>SL; discussed in the UA
1,1,1-Trichloroethane	54	3	5.56	0.035	0.45	0.1	1	200	Not a COPC-MDC<SL
1,2-Dichlorobenzene	54	3	5.56	0.071	0.13	0.2	1	600	Not a COPC-MDC<SL
1,4-Dichlorobenzene	54	4	7.41	0.24	0.81	0.2	1	75	Not a COPC-MDC<SL
Arsenic	14	14	100	1.57	4.27			10	Not a COPC-MDC<SL
Barium	14	14	100	38.9	116			1,000	Not a COPC-MDC<SL
Cadmium	14	3	21.43	0.03	0.04	0.02	0.02	5	Not a COPC-MDC<SL
Chlorobenzene	54	3	5.56	0.14	1.3	0.1	1	100	Not a COPC-MDC<SL
Chloroform	54	7	12.96	0.11	0.31	0.1	1	70	Not a COPC-MDC<SL
Chromium	14	14	100	0.7	1.5			100	Not a COPC-MDC<SL
cis-1,2-Dichloroethene	54	32	59.26	0.035	19	0.1	1	70	Not a COPC-MDC<SL
Copper	14	14	100	0.7	3			1,300	Not a COPC-MDC<SL
Iron	28	10	35.71	11.3	139	10	10	300	Not a COPC-MDC<SL
Lead	14	5	35.71	0.02	0.086	0.02	0.02	15	Not a COPC-MDC<SL
Manganese	14	6	42.86	0.7	4.5	0.6	0.6	50	Not a COPC-MDC<SL
Nitrate/Nitrite	28	28	100	400	3200			10,000	Not a COPC-MDC<SL
trans-1,2-Dichloroethene	54	11	20.37	0.031	0.26	0.1	1	100	Not a COPC-MDC<SL
1,1-Dichloroethane	54	1	1.85	0.043	0.043	0.1	1	2.7	Not a COPC-MDC<SL & DF<5%
1,3-Dichlorobenzene	54	2	3.70	0.06	0.062	0.2	1	600	Not a COPC-MDC<SL & DF<5%
Chloroethane	54	1	1.85	0.15	0.15	0.25	5	2,100	Not a COPC-MDC<SL & DF<5%
Vinyl chloride	54	1	1.85	0.016	0.016	0.02	1	0.2	Not a COPC-MDC<SL & DF<5%
cis-1,3-Dichloropropene	54	0	0.00			0.1	4	4	Not a COPC-ND & MRL Equals the SL
1,1,2,2-Tetrachloroethane	54	0	0.00			0.1	1	2	Not a COPC-ND and MRL<SL
1,1,2-Trichloro-1,2,2-trifluoroethane	15	0	0.00			0.5	1	5,500	Not a COPC-ND and MRL<SL
1,1,2-Trichloroethane	54	0	0.00			0.1	1	3	Not a COPC-ND and MRL<SL
1,1-Dichloroethene	54	0	0.00			0.1	1	7	Not a COPC-ND and MRL<SL
1,2,4-Trichlorobenzene	54	0	0.00			0.2	1	70	Not a COPC-ND and MRL<SL
1,2,4-Trimethylbenzene	54	0	0.00			0.1	1	1.5	Not a COPC-ND and MRL<SL
1,2-Dichloroethane	54	0	0.00			0.1	1	4	Not a COPC-ND and MRL<SL
1,2-Dichloropropane	54	0	0.00			0.1	4	5	Not a COPC-ND and MRL<SL
1,3,5-Trimethylbenzene	54	0	0.00			0.1	1	12	Not a COPC-ND and MRL<SL
1,3-Dichloropropane	54	0	0.00			0.1	1	37	Not a COPC-ND and MRL<SL
1,3-Dichloropropene	3	0	0.00			0.5	0.5	4	Not a COPC-ND and MRL<SL
2-Butanone	16	0	0.00			5	10	560	Not a COPC-ND and MRL<SL
2-Chlorotoluene	54	0	0.00			0.1	1	24	Not a COPC-ND and MRL<SL
4-Chlorotoluene	54	0	0.00			0.2	1	25	Not a COPC-ND and MRL<SL
4-Methyl-2-pentanone	16	0	0.00			5	10	120	Not a COPC-ND and MRL<SL
Acetone	16	0	0.00			10	20	1,400	Not a COPC-ND and MRL<SL
Benzene	54	0	0.00			0.1	1	5	Not a COPC-ND and MRL<SL
Bromobenzene	54	0	0.00			0.1	1	6.2	Not a COPC-ND and MRL<SL
Bromochloromethane	54	0	0.00			0.1	1	8.3	Not a COPC-ND and MRL<SL
Bromodichloromethane	54	0	0.00			0.1	1	10	Not a COPC-ND and MRL<SL
Bromoform	54	0	0.00			0.1	4	80	Not a COPC-ND and MRL<SL
Bromomethane	54	0	0.00			0.1	5	10	Not a COPC-ND and MRL<SL
Carbon disulfide	1	0	0.00			1	1	81	Not a COPC-ND and MRL<SL
Carbon tetrachloride	54	0	0.00			0.1	1	3	Not a COPC-ND and MRL<SL
Chloromethane	54	0	0.00			0.1	5	30	Not a COPC-ND and MRL<SL
Dibromochloromethane	54	0	0.00			0.1	1	4	Not a COPC-ND and MRL<SL
Dichlorodifluoromethane	54	0	0.00			0.4	1	1,000	Not a COPC-ND and MRL<SL
Diisopropyl ether	3	0	0.00			0.5	0.5	150	Not a COPC-ND and MRL<SL
Ethylbenzene	54	0	0.00			0.1	1	700	Not a COPC-ND and MRL<SL
Hexachlorobutadiene	54	0	0.00			0.2	1	5	Not a COPC-ND and MRL<SL
Isopropylbenzene	54	0	0.00			0.1	1	45	Not a COPC-ND and MRL<SL
m,p-Xylenes	42	0	0.00			0.2	2	10,000	Not a COPC-ND and MRL<SL
Methyl tert-butyl ether	41	0	0.00			0.1	1	30	Not a COPC-ND and MRL<SL
Methylene chloride	54	0	0.00			0.5	4	5	Not a COPC-ND and MRL<SL
Naphthalene	54	0	0.00			0.4	4	100	Not a COPC-ND and MRL<SL
n-Butylbenzene	54	0	0.00			0.1	1	100	Not a COPC-ND and MRL<SL
n-Propylbenzene	54	0	0.00			0.1	1	66	Not a COPC-ND and MRL<SL
o-Xylene	42	0	0.00			0.1	1	10,000	Not a COPC-ND and MRL<SL
sec-Butylbenzene	54	0	0.00			0.1	1	200	Not a COPC-ND and MRL<SL
Selenium	14	0	0.00			1	1	50	Not a COPC-ND and MRL<SL
Styrene	54	0	0.00			0.1	1	100	Not a COPC-ND and MRL<SL
tert-Butylbenzene	54	0	0.00			0.1	1	69	Not a COPC-ND and MRL<SL
Toluene	54	0	0.00			0.1	1	1,000	Not a COPC-ND and MRL<SL
Trichlorofluoromethane	54	0	0.00			0.1	1	10,000	Not a COPC-ND and MRL<SL
Trihalomethanes, Total	4	0	0.00			0.5	3.5	100	Not a COPC-ND and MRL<SL
Xylenes, total	16	0	0.00			0.5	3	10,000	Not a COPC-ND and MRL<SL
1,1-Dichloropropene	54	0	0.00			0.1	1		Not a COPC-SL NA
2-Nitropropane	1	0	0.00			10	10		Not a COPC-SL NA
4-Isopropyltoluene	54	0	0.00			0.2	1		Not a COPC-SL NA
Acrylonitrile	1	0	0.00			10	10		Not a COPC-SL NA
Alkalinity, bicarbonate	14	14	100	230,000	250,000				Not a COPC-SL NA
Alkalinity, carbonate	14	0	0.00			5,000	5,000		Not a COPC-SL NA
Alkalinity, hydroxide	14	0	0.00			5,000	5,000		Not a COPC-SL NA
Alkalinity, total	28	28	100	192,000	250,000				Not a COPC-SL NA
Allyl chloride	12	0	0.00			4	4		Not a COPC-SL NA
Chloride	28	28	100	6,500	15,000				Not a COPC-SL NA
Dichlorofluoromethane	12	0	0.00			1	1		Not a COPC-SL NA
Diethyl ether (Ethyl ether)	12	0	0.00			4	4		Not a COPC-SL NA
Ethane	14	0	0.00			10	10		Not a COPC-SL NA
Ethene	14	0	0.00			10	10		Not a COPC-SL NA
Ethyl methacrylate	1	0	0.00			4	4		Not a COPC-SL NA
Ethyl tert-butyl ether (ETBE)	3	0	0.00			0.5	0.5		Not a COPC-SL NA
Extractable Petroleum Hydrocarbons, Total	8	0	0.00			199	218		Not a COPC-SL NA
Methane	14	0	0.00			1.2	10		Not a COPC-SL NA
Methyl Methacrylate	1	0	0.00			5	5		Not a COPC-SL NA
Nitrogen	7	5	71.43	100	280	200	200		Not a COPC-SL NA
Phosphorus	21	11	52.38	34	274	50	100		Not a COPC-SL NA
Sulfate	30	30	100	29,000	200,000				Not a COPC-SL NA
Tert-amyl methyl ether (TAME)	3	0	0.00			0.5	0.5		Not a COPC-SL NA
tert-Butyl Alcohol	3	0	0.00			2	2		Not a COPC-SL NA
Tetrahydrofuran	12	0	0.00			10	10		Not a COPC-SL NA
Total Kjeldahl Nitrogen	21	11	52.38	107	539	100	927		Not a COPC-SL NA
Total Organic Carbon	28	28	100	1,100	7,300				Not a COPC-SL NA
trans-1,4-Dichloro-2-butene	1	0	0.00			10	10		Not a COPC-SL NA
2,2-Dichloropropane	54	1	1.85	0.091	0.091	0.1	4		Not a COPC-SL NA & DF<5%

Notes:

Shading indicates compound of potential concern (COPC).

DF = detection frequency.

MDC = maximum detected concentration.

MRL = maximum reporting limit.

ND = not detected.

SL = screening level.

SLNA = screening level not available.

ug/L = micrograms per liter.

Includes groundwater data collected between July 2010 and July 2013.

COPC = compound of potential concern.

UA = uncertainty analysis (Table 7-1 provides a discussion of the uncertainties associated with the risk assessment process).

**Table 3-1 Exposure Assumptions for the Future Commercial/Industrial Worker
BNSF Mission Wye, Livingston, Montana**

General Assumptions	Site-Specific Value	Units	Reference
BW (body weight)	80	kg	Recommended exposure factor (USEPA 2011a; MDEQ 2012)
AT (averaging times):			
Carcinogenic effects	78	yrs	Recommended exposure factor for life expectancy (USEPA 2011a; MDEQ 2012)
Chronic effects (noncarc.)	25	yrs	Recommended averaging time for commercial/industrial worker (MDEQ 2012, 2009; USEPA 1991,2014)
Surface Soil Exposure Assumptions			
ED (exposure duration)	25	yrs	Recommended exposure duration for commercial/industrial worker (MDEQ 2012, 2009; USEPA 1991, 2014)
EF (exposure frequency)	187	days/yr	Standard default exposure factor; assumes a standard 5-day work week, 3 months of snow cover/frozen ground, and a 2 week vacation (MDEQ 2012)
Dermal Contact			
EV (exposure event)	1	events/day	1993 RA value; recommended CTE and RME value for an industrial worker (USEPA 2004, Exhibit 3-5)
BSAE (body surface area exposed)	3,470	cm ²	Average surface area for exposed head, forearms, and hands for adult males and females (USEPA 2011b, Table 7-2)
AF (soil adherence factor)	0.12	mg/cm ²	Arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities (USEPA 2014; USEPA 2011a, Table 7-20 and Section 7.2.2)
FC (fraction of site soil potentially impacted)	100%		1993 RA value; assumes 100% of area soils are potentially impacted
ABS _d (dermal absorption fraction from soil)	chemical-specific	unitless	See Table 5-1 for additional information (USEPA 2004)
Intake Factor (carcinogenic)	8.55E-07	Kg-soil/Kg-BW/day	Note, the receptor-specific intake factors presented here do not account for chemical-specific dermal absorption factors which will be considered in the risk assessment as warranted.
Intake Factor (noncancer)	2.67E-06	Kg-soil/Kg-BW/day	
Inhalation of Dust/Volatiles			
ET (exposure time)	8	hr/day	Based on normal 8-hour work day (USEPA 2014; MDEQ 2009)
Intake Factor (carcinogenic)	5.47E-02	unitless	Note, the receptor-specific intake factors presented here do not account for the particulate emission factor (PEF) or chemical-specific volatilization factor (VF) which will be considered in the risk assessment as warranted.
Intake Factor (noncancer)	1.71E-01	unitless	
Incidental Ingestion			
IR (ingestion rate)	100	mg/day	Recommended default value for outdoor workers (USEPA 2014; 1991).
FI (fraction ingested)	100%		Worst-case assumption that all soil ingested is from the Facility
AAF (absorption adjustment factor)	chemical-specific	unitless	Absorption assumed to be 100 percent for COPC at the Facility.
Intake Factor (carcinogenic)	2.05E-07	Kg-soil/Kg-BW/day	Note, the receptor-specific intake factors presented here do not account for chemical-specific oral absorption adjustment factors which will be considered in the risk assessment as warranted.
Intake Factor (noncancer)	6.40E-07	Kg-soil/Kg-BW/day	

Notes:

CTE = Central Tendency Exposure.

RME = Reasonable Maximum Exposure.

1993 RA refers to the 1993 *Revised Risk Assessment*, completed by Remediation Technologies, Inc. (RETEC) for Burlington Northern Railroad, Mission Wye, Montana. March 1993.

References:

- 1) MDEQ. 2009. Montana Tier 1 Risk Based Corrective Action Guidance for Petroleum Releases. Appendix E. September 2009.
- 2) MDEQ. 2012. Frequently Asked Questions (FAQs). Available online at <http://deq.mt.gov/StateSuperfund/frequentlyaskedquestions.mcp>
- 3) USEPA. 1991. Risk Assessment Guidance for Superfund, Volume I— Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). EPA/540/R-92/003. Washington D.C.: United States Environmental Protection Agency, Office of Emergency and Remedial Response. December 1991.
- 4) USEPA. 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Final July 2004.
- 5) USEPA. 2011a. Exposure Factor Handbook: 2011 Edition. EPA/600/R-090/052F. September 2011.
- 6) USEPA. 2011b. Highlights of the Exposure Factor Handbook: 2011 Edition. EPA/600/R-10/030. October 2011.
- 7) USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Attachment 1. Recommended Default Exposure Factors. OSWER Directive 9200.1-120. February 2014.

**Table 3-2 Exposure Assumptions for the Future Construction/Excavation Worker
BNSF Mission Wye, Livingston, Montana**

General Assumptions	Site-Specific Value	Units	Reference
BW (body weight)	80	kg	Recommended exposure factor (USEPA 2011; MDEQ 2012)
AT (averaging times):			
Carcinogenic effects	78	yrs	Recommended exposure factor for life expectancy (USEPA 2011; MDEQ 2012)
Chronic effects (noncarc.)	1	yrs	Recommended duration for construction/excavation workers (MDEQ 2012, 2009; USEPA 2002)
Surface and Subsurface Soil Exposure Assumptions			
ED (exposure duration)	1	yrs	Recommended duration for construction/excavation workers (MDEQ 2012, 2009; USEPA 2002)
EF (exposure frequency)	124	days/yr	Recommended value for excavation scenario based on 4 months of open excavation (MDEQ 2009, 2012)
Dermal Contact			
EV (exposure event)	1	events/day	Recommended CTE and RME value for an industrial worker (USEPA 2004; Exhibit 3-5)
BSAE (body surface area exposed)	3,470	cm ²	Average surface area for exposed head, forearms, and hands for adult males and females (USEPA 2011b, Table 7-2)
AF (soil adherence factor)	0.21	mg/cm ²	Mean adherence factor weighted by body part and activity (construction activities) (USEPA 2011b, Tables 7-2 and 7-3)
FC (fraction of site soil potentially impacted)	100%		Assumes 100% of area soils are potentially impacted
ABS _d (dermal absorption fraction from soil)	chemical-specific	unitless	See Table 5-1 for additional information
Intake Factor (carcinogenic)	3.97E-08	Kg-soil/Kg-BW/day	Note, the receptor-specific intake factors presented here do not account for chemical-specific dermal absorption factors which will be considered in the risk assessment as warranted.
Intake Factor (noncancer)	3.09E-06	Kg-soil/Kg-BW/day	
Inhalation of Dust/Volatiles			
ET (exposure time)	8	hrs/day	Based on normal 8-hour work day (MDEQ 2009)
Intake Factor (carcinogenic)	1.45E-03	unitless	Note, the receptor-specific intake factors presented here do not account for the particulate emission factor (PEF) or chemical-specific volatilization factor (VF) which will be considered in the risk assessment as warranted.
Intake Factor (noncancer)	1.13E-01	unitless	
Incidental Ingestion			
IR (ingestion rate)	330	mg/day	Recommended ingestion rate for construction workers (USEPA 2002, Exhibit 5-1; MDEQ 2012, 2009)
FI (fraction ingested)	100%		Worst-case assumption that all soil ingested is from the Facility
AAF (absorption adjustment factor)	chemical-specific	unitless	Absorption assumed to be 100 percent for COPC at the Facility.
Intake Factor (carcinogenic)	1.80E-08	Kg-soil/Kg-BW/day	Note, the receptor-specific intake factors presented here do not account for chemical-specific oral absorption adjustment factors which will be considered in the risk assessment as warranted.
Intake Factor (noncancer)	1.40E-06	Kg-soil/Kg-BW/day	

Notes:

CTE = Central Tendency Exposure.
RME = Reasonable Maximum Exposure.

References:

- 1) MDEQ. 2009. Montana Tier 1 Risk Based Corrective Action Guidance for Petroleum Releases. Appendix E. September 2009.
- 2) MDEQ. 2012. Frequently Asked Questions (FAQs). Available online at <http://deq.mt.gov/StateSuperfund/frequentlyaskedquestions.mcp>
- 3) USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. OSWER 9355.4-24. December.
- 4) USEPA. 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Final July 2004.
- 5) USEPA. 2011. Exposure Factor Handbook: 2011 Edition. EPA/600/R-090/052F. September 2011.

**Table 3-3 Exposure Assumptions for the Future Visitor (Trespasser), Adolescent 6-18 Years
BNSF Mission Wye, Livingston, Montana**

General Assumptions	Site-Specific Value	Units	Reference
BW (body weight)	45	kg	Recommended value for adolescent trespasser scenario (MDEQ 2012)
AT (averaging times):			
Carcinogenic effects	78	yrs	Recommended exposure factor for life expectancy (USEPA 2011; MDEQ 2012)
Chronic effects (noncarc.)	13	yrs	Based on adolescent exposure 6 -18 years old (MDEQ 2012)
Surface Soil Exposure Assumptions			
EF (exposure frequency)	75	days/yr	Based on assumption of 2 days per week and 3 months of snow cover/frozen ground (MDEQ 2012)
ED (exposure duration)	13	yrs	Based on adolescent exposure 6 -18 years old (MDEQ 2012)
Dermal Contact			
EV (exposure event)	1	events/day	1993 RA value; Recommended CTE and RME value for a resident (USEPA 2004; Exhibit 3-5)
B _{SAE} (body surface area exposed)	4,380	cm ²	Average surface area for exposed head, forearms, and hands, lower legs and feet for children aged 6 to 18 years old (USEPA 2011b, Table 7-2)
AF (soil adherence factor)	0.0392	mg/cm ²	Mean adherence factor weighted by body part and activity (outdoor sports) for child aged 6 to 18 years (USEPA 2011b, Tables 7-2 and 7-3)
FC (fraction of site soil potentially impacted)	100%		1993 RA value; assumes 100% of area soils are potentially impacted
ABS _d (dermal absorption fraction from soil)	chemical-specific	unitless	See Table 5-1 for additional information
	Intake Factor (carcinogenic)	1.31E-07	Kg-soil/Kg-BW/day
	Intake Factor (noncancer)	7.84E-07	Kg-soil/Kg-BW/day
Note, the receptor-specific intake factors presented here do not account for chemical-specific dermal absorption factors which will be considered in the risk assessment as warranted.			
Inhalation of Dust/Particulates			
ET (exposure time)	2	hrs/day	1993 RA value; based on potential trespasser activities (professional judgment)
	Intake Factor (carcinogenic)	2.85E-03	unitless
	Intake Factor (noncancer)	1.71E-02	unitless
Note, the receptor-specific intake factors presented here do not account for the particulate emission factor (PEF) or chemical-specific volatilization factor (VF) which will be considered in the risk assessment as warranted.			
Incidental Ingestion			
IR (ingestion rate)	100	mg/day	1993 RA value; recommended value for trespasser scenario (MDEQ 2012)
FI (fraction ingested)	100%		Worst-case assumption that all soil ingested is from the Facility
AAF (absorption adjustment factor)	chemical-specific	unitless	Absorption assumed to be 100 percent for COPC at the Facility.
	Intake Factor (carcinogenic)	7.61E-08	Kg-soil/Kg-BW/day
	Intake Factor (noncancer)	4.57E-07	Kg-soil/Kg-BW/day
Note, the receptor-specific intake factors presented here do not account for chemical-specific oral absorption adjustment factors which will be considered in the risk assessment as warranted.			

Notes:

CTE = Central Tendency Exposure.

RME = Reasonable Maximum Exposure.

1993 RA refers to the 1993 *Revised Risk Assessment*, completed by Remediation Technologies, Inc. (RETEC) for Burlington Northern Railroad, Mission Wye, Montana. March 1993.

References:

- 1) MDEQ. 2012. Frequently Asked Questions (FAQs). Available online at <http://deq.mt.gov/StateSuperfund/frequentlyaskedquestions.mcp>
- 2) USEPA. 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Final July 2004.
- 3) USEPA. 2011. Exposure Factor Handbook: 2011 Edition. EPA/600/R-090/052F. September 2011.

**Table 3-4 Exposure Assumptions for the Future Resident, Adult and Child 0-6 Years
BNSF Mission Wye, Livingston, Montana**

General Assumptions	Site-Specific Value	Units	Reference
BW (body weight) - adult	80	kg	Recommended exposure factor (USEPA 2011; MDEQ 2012)
BW (body weight) - child	15	kg	1993 RA value; standard default exposure factor (USEPA 1989, 1991; MDEQ 2012, 2009)
AT (averaging times):			
Carcinogenic effects	78	yrs	Recommended exposure factor for life expectancy (USEPA 2011; MDEQ 2012)
Chronic effects (noncarc.) - adult	26	yrs	Standard default - adult (USEPA 2014)
Chronic effects (noncarc.) - child	6	yrs	Standard default - child (USEPA 1991; MDEQ 2009, 2012)
Surface Soil Exposure Assumptions			
EF (exposure frequency)	270	days/yr	Standard default exposure factor; assumes 3 months of snow cover/frozen ground, and a 2 week vacation (MDEQ 2012)
ED (exposure duration) - adult	26	yrs	Standard default - adult (USEPA 2014)
ED (exposure duration) - child	6	yrs	Standard default - child (USEPA 1991; MDEQ 2009, 2012)
Dermal Contact			
EV (exposure event)	1	events/day	Recommended CTE and RME value for a resident (USEPA 2004; Exhibit 3-5)
BSAE (body surface area exposed) - adult	6,032	cm ²	Weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years) (forearm and lower leg-specific data used for males and female lower leg; ratio of male forearm to arm applied to female arm data (USEPA 2014, 2011, Tables 7-2 and 7-12)
BSAE (body surface area exposed) - child	2,690	cm ²	Weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to <6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere (USEPA 2014, 2011; Tables 7-2 and 7-8)
AF (soil adherence factor) - adult	0.07	mg/cm ²	Recommended default value for resident adults (USEPA 2014, 2004; Exhibit 3-5)
AF (soil adherence factor) - child	0.2	mg/cm ²	Recommended default value for child residents (USEPA 2014, 2004; Exhibit 3-5)
FC (fraction of site soil potentially impacted)	100%		Assumes 100% of Facility area is potentially impacted
ABS _d (dermal absorption fraction from soil)	chemical-specific	unitless	See Table 5-1 for additional information
Intake Factor (carcinogenic) - Adult	1.30E-06	Kg-soil/Kg-BW/day	
Intake Factor (noncancer) - Adult	3.90E-06	Kg-soil/Kg-BW/day	Note, the receptor-specific intake factors presented here do not account for chemical-specific dermal absorption factors which will be considered in the risk assessment as warranted.
Intake Factor (carcinogenic) - Child	2.04E-06	Kg-soil/Kg-BW/day	
Intake Factor (noncancer) - Child	2.65E-05	Kg-soil/Kg-BW/day	
Inhalation of Dust/Particulates			
ET (exposure time)	24	hrs/day	Assumes continued inhalation of dust/particulates both indoors and outdoors
	24	hrs/day	Assumes continued inhalation of dust/particulates both indoors and outdoors
Intake Factor (carcinogenic) - Adult	2.47E-01	unitless	
Intake Factor (noncancer) - Adult	7.40E-01	unitless	Note, the receptor-specific intake factors presented here do not account for the particulate emission factor (PEF) or chemical-specific volatilization factor (VF) which will be considered in the risk assessment as warranted.
Intake Factor (carcinogenic) - Child	5.69E-02	unitless	
Intake Factor (noncancer) - Child	7.40E-01	unitless	
Incidental Ingestion			
IR (ingestion rate)	100	mg/day	Recommended adult ingestion rate (USEPA 2014, 1991)
	200	mg/day	Recommended child ingestion rate (MDEQ 2009, 2012)
FI (fraction ingested)	100%		Worst-case assumption that all soil ingested is from the Facility
AAF (absorption adjustment factor)	chemical-specific	unitless	Absorption assumed to be 100 percent for COPC at the Facility.
Intake Factor (carcinogenic) - Adult	3.08E-07	Kg-soil/Kg-BW/day	
Intake Factor (noncancer) - Adult	9.25E-07	Kg-soil/Kg-BW/day	Note, the receptor-specific intake factors presented here do not account for chemical-specific oral absorption adjustment factors which will be considered in the risk assessment as warranted.
Intake Factor (carcinogenic) - Child	7.59E-07	Kg-soil/Kg-BW/day	
Intake Factor (noncancer) - Child	9.86E-06	Kg-soil/Kg-BW/day	

Notes:

CTE = Central Tendency Exposure.

RME = Reasonable Maximum Exposure.

1993 RA refers to the 1993 *Revised Risk Assessment*, completed by Remediation Technologies, Inc. (RETEC) for Burlington Northern Railroad, Mission Wye, Montana. March 1993.

References:

- 1) MDEQ. 2009. Montana Tier 1 Risk Based Corrective Action Guidance for Petroleum Releases. Appendix E. September 2009.
- 2) MDEQ. 2012. Frequently Asked Questions (FAQs). Available online at <http://deq.mt.gov/StateSuperfund/frequentlyaskedquestions.mcp>
- 3) USEPA. 1989. Risk Assessment Guidance for Superfund, Volume 1—Human Health Evaluation Manual (Part A). EPA/540/1-89/002. Washington D.C.: United States Environmental Protection Agency, Office of Emergency and Remedial Response. December 1989.
- 4) USEPA. 1991. Risk Assessment Guidance for Superfund, Volume I— Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). EPA/540/R-92/003. Washington D.C.: United States Environmental Protection Agency, Office of Emergency and Remedial Response. December 1991.
- 5) USEPA. 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. Final July 2004.
- 6) USEPA. 2011. Exposure Factor Handbook: 2011 Edition. EPA/600/R-090/052F. September 2011.
- 7) USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Attachment 1. Recommended Default Exposure Factors. OSWER Directive 9200.1-120. February 2014.

**Table 3-5 Exposure Point Concentrations for Soil Compounds of Potential Concern
BNSF Mission Wye, Livingston, Montana**

Interval	COPC	CAS Number	Number of Samples	Number of Detections	Detection Frequency (%)	Max Concentration (mg/kg)	Max Reporting Limit (mg/kg)	Average Concentration (mg/kg)	Type of Distribution	Statistical Method	Calculated UCL (mg/kg)	Exposure Point Concentration (mg/kg)	Basis for EPC	Notes
Surface Soil (0-2 ft bgs)	Tetrachloroethene	127-18-4	23	11	47.83	204	1.14	8.98	Nonparametric	99% KM (Chebyshev) UCL	99.45	99.45	UCL	Applies a 99% confidence level for the mean of the data based on Chebyshev inequality for heterogeneous non-parametric distributions as recommended by ProUCL v4.1.1
	Trichloroethene	79-01-6	23	6	26.09	76.3	57.1	4.60	Nonparametric	99% KM (Chebyshev) UCL	38.7	38.7	UCL	
Subsurface Soil (0-10 ft bgs)	Tetrachloroethene	127-18-4	46	16	34.78	204	1.14	4.82	Nonparametric	99% KM (Chebyshev) UCL	51.87	51.87	UCL	
	Trichloroethene	79-01-6	46	10	21.74	76.3	57.1	2.56	Nonparametric	99% KM (Chebyshev) UCL	20.68	20.68	UCL	

Notes:

COPC = compound of potential concern.
mg/kg = milligrams per kilogram.
UCL = upper confidence limit.
MDC = maximum detected concentration.
RL = reporting limit.
EPC = exposure point concentration.
NA = not applicable.

Reference:

1) USEPA 2011. ProUCL version 4.1.1. Office of Research and Development, National Exposure Research Laboratory, Las Vegas, NV. Available online at <http://www.epa.gov/herlesd1/tsc/form.htm>

**Table 5-1 Toxicity Values and Chemical-Specific Properties for Soil Compounds of Potential Concern
BNSF Mission Wye, Somers, Montana**

Soil COPC	CAS Number	Volatile?	Mutagen?	GI _{ABS}	AAF	ABS _D	Target Organ / Endpoint ^{IRIS}	SF _o		IUR		RfD _o		RfC _i		Soil VF ¹ (m ³ /kg)	1/Soil VF (kg/m ³)
								(mg/kg-day) ⁻¹		(ug/m ³) ⁻¹		(mg/kg-day)		(mg/m ³)			
Tetrachloroethene	127-18-4	Yes ¹	No ¹	1 ¹	1 ¹	NA ¹	Neurotoxicity	2.1E-03	IRIS	2.6E-07	IRIS	6.0E-03	IRIS	4.0E-02	IRIS	2,530	3.95E-04
Trichloroethene	79-01-6	Yes ¹	Yes ^{1[a]}	1 ¹	1 ¹	NA ¹	Adult immunological effects; Immunotoxicity; Developmental Immunotoxicity; Heart Malformations; Liver; Kidney; Non-Hodgkin's lymphoma	4.6E-02	IRIS	4.1E-06	IRIS	5.0E-04	IRIS	2.0E-03	IRIS	2,380	4.20E-04

Notes:

[a] USEPA's IRIS profile for trichloroethene indicates sufficient weight of evidence to conclude a mutagenic mode of action is operative for trichloroethene-induced kidney tumors.

AAF = absorption adjustment factor

ABS_D = dermal absorption factor

COPC = compound of potential concern. Toxicity values for soil COPCs presented as risks and cleanup levels will not be calculated for groundwater.

GI_{ABS} = gastrointestinal absorption factor

IUR = inhalation unit risk

m³/kg = cubic meters per kilogram

mg/kg-day = milligrams per kilogram per day

mg/m³ = milligrams per cubic meter

NA = not applicable; volatile compounds do not absorb readily through the skin

PEF = particulate emission factor

RfD_o = oral reference dose

RfC_i = inhalation reference concentration

SF_o = oral cancer slope factor

ug/m³ = micrograms per cubic meter

VF = volatilization factor

References:

IRIS = USEPA's Integrated Risk Information System. Available online at: epa.gov/iris

1) USEPA. 2014. Regional Screening Level Summary Table. May 2014 update. Available online at: <http://www.epa.gov/region9/superfund/prg/>

**Table 6-1 Surface Soil Risk Estimates for the Future Commercial/Industrial Worker
BNSF Misson Wye, Livingston, Montana**

COPC	Surface Soil EPC (mg/kg)	Risk: Noncancer Effects				Risk: Cancer Effects				
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined	
Tetrachloroethene	99.45	1.06E-02	NA	1.68E-01	1.78E-01	4.29E-08	NA	5.59E-07	6.02E-07	
Trichloroethene	38.7	4.96E-02	NA	1.39E+00	1.44E+00	3.65E-07	NA	3.65E-06	4.01E-06	
Cumulative Risk:		Noncancer HI				1.6	Cancer Risk			4.6E-06

Notes:

COPC = compound of potential concern.

EPC = exposure point concentration.

HI = hazard index.

NA = not applicable.

mg/kg = milligrams per kilogram.

shading = exceedance of MDEQ's acceptable cancer target risk level (TRL) of 1×10^{-5} or noncancer hazard index (HI) of 1.

Appendix C (Table C-1) provides the inputs used in calculating the risk estimates summarized here.

**Table 6-2 Soil Risk Estimates for the Future Construction/Excavation Worker
BNSF Mission Wye, Livingston, Montana**

COPC	Surface Soil EPC (mg/kg)	Risk: Noncancer Effects				Risk: Cancer Effects				
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined	
Tetrachloroethene	99.45	2.32E-02	NA	1.11E-01	1.35E-01	3.75E-09	NA	1.48E-08	1.86E-08	
Trichloroethene	38.7	1.08E-01	NA	9.21E-01	1.03E+00	3.20E-08	NA	9.68E-08	1.29E-07	
Cumulative Risk:		Noncancer HI				1.2	Cancer Risk			1.5E-07

COPC	Subsurface Soil EPC (mg/kg)	Risk: Noncancer Effects				Risk: Cancer Effects				
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined	
Tetrachloroethene	51.87	1.21E-02	NA	5.80E-02	7.02E-02	1.96E-09	NA	7.74E-09	9.70E-09	
Trichloroethene	20.68	5.80E-02	NA	4.92E-01	5.50E-01	1.71E-08	NA	5.17E-08	6.88E-08	
Cumulative Risk:		Noncancer HI				0.6	Cancer Risk			7.9E-08

Notes:

COPC = compound of potential concern.

EPC = exposure point concentration.

HI = hazard index.

NA = not applicable.

mg/kg = milligrams per kilogram.

shading = exceedance of MDEQ's acceptable cancer target risk level (TRL) of 1×10^{-5} or noncancer hazard index (HI) of 1.

Appendix C (Table C-2) provides the inputs used in calculating the risk estimates summarized here.

**Table 6-3 Surface Soil Risk Estimates for the Future Visitor/Trespasser, Adolescent
BNSF Mission Wye, Livingston, Montana**

COPC	Surface Soil EPC (mg/kg)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	99.45	7.57E-03	NA	1.68E-02	2.44E-02	1.59E-08	NA	2.92E-08	4.51E-08
Trichloroethene	38.7	3.53E-02	NA	1.39E-01	1.75E-01	4.06E-07	NA	5.71E-07	9.77E-07
Cumulative Risk:		Noncancer HI			0.2	Cancer Risk			1.0E-06

Notes:

COPC = compound of potential concern.

EPC = exposure point concentration.

HI = hazard index.

NA = not applicable.

mg/kg = milligrams per kilogram.

Appendix C (Table C-3) provides the inputs used in calculating the risk estimates summarized here.

**Table 6-4 Surface Soil Risk Estimates for the Future Resident, Adult and Child
BNSF Mission Wye, Livingston, Montana**

COPC	Surface Soil EPC (mg/kg)	Adult Resident								
		Risk: Noncancer Effects				Risk: Cancer Effects				
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined	
Tetrachloroethene	99.45	1.53E-02	NA	7.27E-01	7.42E-01	6.44E-08	NA	2.52E-06	2.58E-06	
Trichloroethene	38.7	7.16E-02	NA	6.01E+00	6.09E+00	5.49E-07	NA	1.64E-05	1.70E-05	
Cumulative Risk:		Noncancer HI				6.8	Cancer Risk			2.0E-05

COPC	Surface Soil EPC (mg/kg)	Child Resident								
		Risk: Noncancer Effects				Risk: Cancer Effects				
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined	
Tetrachloroethene	99.45	1.63E-01	NA	7.27E-01	8.90E-01	1.58E-07	NA	5.82E-07	7.40E-07	
Trichloroethene	38.7	7.63E-01	NA	6.01E+00	6.78E+00	1.35E-05	NA	3.79E-05	5.14E-05	
Cumulative Risk:		Noncancer HI				7.7	Cancer Risk			5.2E-05

Notes:

COPC = compound of potential concern.

EPC = exposure point concentration.

HI = hazard index.

NA = not applicable.

mg/kg = milligrams per kilogram.

shading = exceedance of MDEQ's acceptable cancer target risk level (TRL) of 1×10^{-5} or noncancer hazard index (HI) of 1.

**Table 6-5 Groundwater Locations Exceeding DEQ-7 Standards
BNSF Mission Wye, Livingston, Montana**

Well Location	Sample Date	COPC	CAS Number	Concentration (µg/L)	Groundwater Screening Level (µg/L)
MW-22	7/13/2011	Tetrachloroethene	127-18-4	18	5
MW-22	7/30/2013	Tetrachloroethene	127-18-4	6.5	5
MW-3	7/14/2010	Tetrachloroethene	127-18-4	37	5
MW-3	7/13/2011	Tetrachloroethene	127-18-4	260	5
MW-3	7/3/2012	Tetrachloroethene	127-18-4	30	5
MW-3	7/9/2013	Tetrachloroethene	127-18-4	93	5
MW-3	7/13/2011	Trichloroethene	79-01-6	27	5
MW-3	7/9/2013	Trichloroethene	79-01-6	5.3	5
MW-4 (Duplicate)	7/3/2012	Tetrachloroethene	127-18-4	5.5	5
MW-4	7/3/2012	Tetrachloroethene	127-18-4	5.3	5
MW-9	7/13/2011	Tetrachloroethene	127-18-4	8.6	5

Notes:

µg/L = micrograms per liter.

COPC = compound of potential concern.

**Table 6-6 Evaluation of Soil Locations Exceeding Site-Specific Leaching Cleanup Levels
BNSF Mission Wye, Livingston, Montana**

sys_loc_code	Sample Name	End Depth (ft)	Sample Date	COPC	CAS Number	Concentration (mg/kg)	Background Range (mg/kg)	Within Background Range?	Site-Specific Cleanup Level (mg/kg)	Present in Nearby Downgradient Groundwater Well?	SPLP Result Available?	Rationale for Further Evaluation in FS?
ALSAB-2	ALSAB-2	3	4/13/2000	Trichloroethene	79-01-6	0.27	--	--	0.10	Yes-MW-4	--	No- Previously excavated area
CC Bottom B	CC Bottom B	6	10/8/1997	Tetrachloroethene	127-18-4	0.5	--	--	0.13	No well present	--	Yes
EC Bottoms A	EC Bottoms A	6	11/20/1997	Tetrachloroethene	127-18-4	0.447	--	--	0.13	No well present	--	Yes
EC Bottoms A	EC Bottoms A	6	11/20/1997	Trichloroethene	79-01-6	0.103	--	--	0.10	No well present	--	Yes
EC Bottoms C	EC Bottoms C	6	12/2/1997	Tetrachloroethene	127-18-4	0.416	--	--	0.13	No well present	--	Yes
SAB-2	SAB-2	3	4/6/2000	Trichloroethene	79-01-6	0.21	--	--	0.10	Yes-MW-4	--	No- Previously excavated area
SBS-2	SBS-2D	7.5	9/14/2007	Iron	7439-89-6	22,400	13,100 to 15,600	No	19,768	Yes-MW-3	--	No - Not significantly above bkg & MNA parameter
SBS-2	SBS-2E	9	9/14/2007	Iron	7439-89-6	20,500	13,100 to 15,600	No	19,768	Yes-MW-3	--	No -Not significantly above bkg & MNA parameter
SBS-7	SBS-7D	3	9/14/2007	Iron	7439-89-6	20,400	13,100 to 15,600	No	19,768	No	--	No - Not present in downgradient well and MNA parameter
SBS-7	SBS-7D	3	9/14/2007	Tetrachloroethene	127-18-4	3.01	--	--	0.13	Yes-MW-5	--	Yes
SBS-7	SBS-7D	3	9/14/2007	Trichloroethene	79-01-6	0.187	--	--	0.10	Yes-MW-5	--	Yes
SS-146	SS-146	0.99	9/13/2007	Tetrachloroethene	127-18-4	0.133	--	--	0.13	Yes-MW-4	--	No- Previously excavated area & PCE conc in gw. at or below DEQ-7 stds
SS-157	SS-157	1.2375	9/13/2007	Tetrachloroethene	127-18-4	0.223	--	--	0.13	Yes-MW-4	Yes - ND but RL>DEQ-7 Std	Yes
SS-83	SS-83	0.825	9/13/2007	Tetrachloroethene	127-18-4	0.527	--	--	0.13	No well present	--	Yes
SS-88	SS-88	0.99	9/13/2007	Tetrachloroethene	127-18-4	0.16	--	--	0.13	No well present	Yes - ND but RL>DEQ-7 Std	Yes
SS-88D	SS-88d	1.340625	9/13/2007	Tetrachloroethene	127-18-4	204	--	--	0.13	No well present	Yes - ND but RL>DEQ-7 Std	Yes
SS-88D	SS-88d	1.340625	9/13/2007	Trichloroethene	79-01-6	76.3	--	--	0.10	No well present	Yes - ND but RL>DEQ-7 Std	Yes

Notes:

- shading = retain for further evaluation in the FS
- ft = feet.
- COPC = compound of potential concern.
- mg/kg = milligrams per kilogram.
- FS = feasibility study.
- SPLP = synthetic precipitation leaching procedure.
- ND = not detected.
- RL = reporting limit.
- not available or not applicable.
- bkg = background.
- MNA = monitored natural attenuation parameter.
- DEQ-7 Std = MDEQ. 2012. Circular DEQ-7, Montana Numeric Water Quality Standards, October. Montana Department of Environmental Quality.

**Table 7-1 Uncertainties Associated with the Human Health Risk Assessment
BNSF Mission Wye, Livingston, Montana**

Assumption	Effect on Risk	Comment
Data Quality		
Sufficient Sample Collection	Ability to completely characterize risk	A sufficient number of representative samples must be collected to characterize media in study areas for the risk assessment. Historical data were used as appropriate to obtain sufficient sample numbers and distribution. Therefore, sufficient samples have been collected and this parameter is unlikely to under-estimate risk. In addition, if residually impacted soil is excavated, the concentrations in groundwater would decrease.
Defining surface soil data as 0-2 ft bgs	Over-estimate or under-estimate	Surface soil was defined as 0 to 2 ft bgs for purposes of the HHRA as the majority of soil data collected at Mission Wye (in accordance with approved sampling Work Plans based on MDEQ guidance) is within this 0 to 2 ft bgs interval. Use of this depth interval as representative of surface conditions is uncertain and receptors such as commercial/industrial workers are unlikely to frequently come into direct contact with soils as deep as 2 ft bgs; their exposure potential is more accurately represented by near surface soil 0 to 0.5 ft bgs.
Data Validation – were any samples rejected?	Omitting data that are unusable may under-estimate risk	Detailed QA/QC is conducted on analytical data to determine data usability (excluding data is in accordance with USEPA 1989). Laboratory reports were reviewed for data adequacy and the data have been validated and determined acceptable for risk assessment purposes. As a result, risk estimates are unlikely to be under-estimated.
Detection Limits-were samples highly diluted?	Over-estimate or under-estimate	If highly diluted data are due to matrix interferences and the data were non-detect, the resulting data could underestimate risks if concentrations are greater than one-half the detection limit, or could overestimate the risk if actual concentrations are less than one-half the detection limit, or could have no effect on risk if the actual data are similar to that reported. Elevated detection limits were noted and non-detected COPC were eliminated from the quantitative risk characterization which may under estimate risk.
Selection of Human Health Chemicals of Potential Concern		
Determining COPC	Over-estimate or under-estimate	<p>Risk evaluation is only completed for those chemicals that been identified as a COPC in a particular medium. Not evaluating chemicals that are not identified as COPC, but were detected, may result in a slight underestimate of risk through additivity.</p> <p>Chemicals that are not detected, but for which the detection limit exceeds a screening level were not carried forward into the quantitative risk characterization. This uncertainty leads to a potential underestimation of risk. Chemicals that were not detected but the reporting limit exceeds the screening level are shown on Tables 2-4 through 2-7.</p> <p>Chemicals that do not have established human health screening levels available are identified as a source of uncertainty. In most cases, the lack of toxicity values and screening levels for these chemicals indicates that they are no considered by USEPA to pose a significant health risk. The elimination of these chemicals may result in a potential under estimation of risk.</p>
Toxicity Assessment		
Development of Toxicity Values (RfD and CSFs)	Over-estimate	To account for the uncertainties associated with the evaluation of toxicity data, such as deriving values from animal studies and applying them to human exposure scenarios, both RfDs and CSFs are derived by USEPA in a way that is intentionally conservative (i.e., uncertainty factors ranging from 1 to 1,000 fold are applied).
Toxicity values derived from animal studies	Over-or-under estimate	Extrapolation from animals to humans may introduce error due to the differences in absorption, pharmacokinetics, target organs, and population variability.
Toxicity data derived primarily from high doses	Over-estimate	Most exposures occur at relatively low doses and toxicity data are derived from animals given 1,000 to 10,000 times the likely human dose.
Using two different sources of toxicity values	Over-estimate or under-estimate	When there is a discrepancy in toxicity values between sources given the available information there may be either an over-or under estimation of risk.
Using dose-response information from short-term exposure to predict the effects of long-term exposures and vice-versa.	Over-estimate or under-estimate	Use of chronic toxicity values to evaluate subchronic exposures may result in a slight to moderate over or underestimation of risk.
Revised Human Health Toxicity Values	Over-or-under estimate	Toxicity values are periodically reviewed and updated. The most current toxicity values for COPC were applied at this time and risks are not likely to be under-estimated.
COPCs without toxicity data available	Under-estimate	USEPA 1989 RAGS states “Toxicity information for many chemicals is often limited. Although some chemicals have no toxicity data available at all because they have not been studied, the reason other chemicals lack toxicity values is because their toxicology databases are limited (few studies) or of poor quality, or the available data cannot be used to develop toxicity values for human health. Additionally, some of the chemicals lacking toxicity values may have adequate toxicology databases but the values may not have been developed or finalized. Because quantitative toxicity data are one of the parameters required for risk calculation, risks were not calculated for those COPCs for which numerical toxicity data are not available. This uncertainty may result in a slight to moderate underestimate of risk”.

**Table 7-1 Uncertainties Associated with the Human Health Risk Assessment
BNSF Mission Wye, Livingston, Montana**

Assumption	Effect on Risk	Comment
Exposure Assessment (Potential Receptors and Exposure Pathways)		
Relevance of the Exposure Scenarios Selected	Over-or-under estimate	Exposure scenarios represent idealized situations that may or may not represent actual, current, or future conditions. Conservative exposure scenarios may potentially over-estimate risk. An example of this includes the evaluation of future residential use of the railroad-owned property. This is an unlikely scenario as BNSF has the right to restrict the current use of its own property. If BNSF would like any restriction to apply to future owners, BNSF would need to place an institutional control on the property. A restriction of any property not owned by BNSF also would require an institutional control to be placed by the property owner. An institutional control under Section 75-10-727, MCA must be approved by MDEQ and must be appropriate based upon the reasonably anticipated further use of the property. MDEQ will determine whether an institutional control is appropriate as part of the selection of the final remedy for the facility; MDEQ will not select the final remedy until the decision document has been subject to public comments, as required by CECRA and the 1990 Modified Partial Consent Decree.
Exposure Assumptions	Over-or-under estimate	Most exposure assumptions are based on the upperbound reasonable maximum exposure (RME) level (most conservative scenario), which is specifically designed to evaluate the exposure to an individual at the high end of the exposure distribution. Using the upper-bound values ensures protection of any sensitive subpopulations, but may potentially over-estimate risk.
Relative absorption factors	Over-estimate	The relative bioavailability of chemicals from soils is highly site-specific and depends on regional mineralogy and contamination types. For this reason, use of published oral RAFs developed for other locations in place of site-specific information is highly uncertain. Therefore, the risk estimates presented do not consider oral absorption (i.e., assumed 100%). This is a conservative assumption as chemicals ingested with an environmental matrix such as soil are likely to have a lower efficiency of uptake than that noted in the critical animal study used to derive the RfD and URF. Risk estimates are likely to be over-estimated.
Dermal Exposure to Volatiles in Soil	Under-estimation	For volatiles COPC it is assumed that the constituent is not absorbed into the skin but instead volatilizes off the skin and is inhaled (USEPA 2004a). Therefore, soil risks for the dermal pathway were not included for volatile COPC (i.e., PCE and TCE) as appropriate and may result in an under-estimation of potential risk.
Exposure Pathways not Evaluated Quantitatively	Under-estimation	Humans may be exposed to COPCs by a wide variety of pathways, but not all of these are likely to be equally important. Omission of such pathways tends to underestimate total exposure and risk, but it is believed that the magnitude of the exposure through these pathways is insignificant compared to the exposure and risk due to the pathways that were evaluated. All complete and potentially significant exposure pathways were included in the risk assessment for Mission Wye. Therefore, it is unlikely that risks were under-estimated.
Defining Exposure Areas	Over or Under-estimation	Separate and distinct exposure areas were not defined. Instead, the railroad-owned and adjacent property was treated as one exposure area for potential soil exposures and receptors were assumed to move freely about the property. This is based on the fact that the area is not very large, is undeveloped, and future use is unknown. However, the assumption that all receptors use the property on an area-wide basis represents an uncertainty as more localized use of select areas could occur. Assessment of soil exposure on an area-wide basis may act to under-estimate risk by masking localized areas of elevated concentrations with areas of lower concentrations (i.e., dilution). However, the magnitude of uncertainty is low given that soils at BNSF Mission Wye have been extensively remediated in the past and remaining concentrations (except those noted at SS-88d) are relatively uniform. In regard to SS-88d (and SBS-7), concentrations are elevated at these locations and have been noted to drive the risks reported at this location. As such, these concentrations do not get diluted with inclusion of additional soil data. Therefore, risks are not likely to be under-estimated. For groundwater, exposure areas were not defined and groundwater data were compared to DEQ-7 standards on a point by point basis.
Exposure Point Concentrations		
Use of the Calculated UCL	Moderate over-estimation	Use of a UCL provides a conservative estimate of average concentrations and can compensate for potential deficiencies in samples size, or systematic or random errors in the chemical analysis.
Use of the Maximum Detected Concentration (MDC)	Over-estimation	When data are non-parametric, the log-normal UCL is conservatively chosen. However, if the log-normal UCL is greater than the MDC, the MDC is used as the EPC. In addition, if the sample size is small (n<10) or consists of a lot of non-detects, the MDC is defaulted to. This is not a representative concentration and will over-estimate risk. However, the MDC was not used as the EPC as adequate data were available to calculate a 99% UCL. As a result, risk estimates are not likely to be over-estimated.
Use of Modeling Factors to Estimate the EPC	Over or Under-estimation	Analytical data from the media of interest is preferred. However, modeling factors can be applied to predict COPC concentrations in media when data has not been collected. The use of modeling factors may act to over-or-under estimate potential media concentrations and subsequent risk depending on how closely the default input parameters or literature assumptions represent site-specific properties. At Mission Wye, USEPA default volatilization factors were used to estimate potential COPC concentrations in ambient air. A degree of uncertainty is associated with this approach.
Combining data across Mission Wye to determine the EPC	Over or under-estimation	This approach represents a reasonable exposure pattern under the assumption that receptor groups move freely across portions of a property and are not inclined to spend more time in any one area. However, combining datasets from applicable exposure areas may mask localized "hot spots" and result in an under-estimation of risk. Contrarily, inclusion of a localized "hot spot" such as SS-88d in the combined dataset may give the false impression that exposures throughout the property are elevated when in fact all the potential risk is due to one area/location.
Sample-by-sample EPC determination and risk	Over-estimation	Only appropriate in certain cases where the potential exposure area a receptor may be exposed is limited. Usually receptors are exposed to large areas of a property. However, in the case of groundwater, receptors are more likely to be exposed in select locations and a point-by-point

**Table 7-1 Uncertainties Associated with the Human Health Risk Assessment
BNSF Mission Wye, Livingston, Montana**

Assumption	Effect on Risk	Comment
evaluation		evaluation was conducted. Therefore, risks are unlikely to be over-estimated.
Nature and Extent of COPCs		
Biased Sampling Plans based on known areas of contamination	Over or under-estimation	If the sampling plan is designed to collect samples from areas of the property with known contamination, sample locations and sample results will be biased high and the dataset may over estimate risk. At Mission Wye, samples were collected from different soil and groundwater locations across the property including areas of lesser impacts and those areas of known or suspected contamination. As such, risks are unlikely to be over-estimated.
Data gaps	Under-estimation	Based on a review of the groundwater and soil sampling locations , there is a data gap of approximately 200 feet between SS-88d and MW-10 where no groundwater or soil samples have been collected. Based on the concentrations in groundwater at MW- 3, the soil gas data, and the distance between the BNSF-identified "source areas" and MW-3, there is potential for additional leaching-to-groundwater soil impacts between SS- 88d and MW-3.
Risk Characterization		
Institutional or engineering controls not taken into account	Over-estimation	<p>Institutional controls are a method for controlling exposure to, or limiting or eliminating migration of COPCs. They often assure that land use scenarios don't change. Not accounting for institutional controls as part of exposure scenarios may potentially over-estimate risk. Currently, BNSF has not put in place any institutional controls, so risks are unlikely to be over-estimated. However, if institutional controls were placed in the future, risks would be lowered.</p> <p>Deed restrictions are an aspect of institutional controls. Deed restrictions along with other factors (e.g. local land use, development, etc.) will be used to determine potential future land use should BNSF sell the property. BNSF may propose institutional controls limiting development on railroad property in the future.</p> <p>An institutional control under Section 75-10-727, MCA, must be approved by MDEQ and must be appropriate based upon the reasonably anticipated future use of the property. MDEQ will determine whether an institutional control is appropriate as part of the selection of the final remedy for the facility; MDEQ will not select the final remedy until the decision document has been subject to public comment, as required by CECRA and the 1990 Modified Partial Consent Decree.</p>
Natural Attenuation of Contaminants not Considered	Over-estimation	Excluding natural processes, such as hydrolysis, photolysis, and biodegradation, will over-estimate risk. Concentrations of chemicals in soil and groundwater degrade over time and pose less risk after natural degradation processes have occurred.
Elimination of COPCs	Under-estimation	<p>Eliminating detected COPCs based on a screening process that do not exceed relevant screening levels at a certain frequency (<5 %), may result in the slight underestimation of risk. These eliminated COPCs may be present at low concentrations and contribute to cumulative risk. However, this is expected to be insignificant to the total risk. It is important to note however that if an analyte was detected at a concentration above screening levels, it was retained as a COPC regardless of detection frequency. This serves to not prematurely eliminate analytes present at elevated concentrations that may contribute to total risk, even though they are infrequently detected.</p> <p>In addition, analytes that were 100% non-detect were not retained as COPC for quantitative risk characterization. As previously discussed, elevated detection limits were noted for several analytes (as demonstrated by reporting limit exceedances of screening levels), which may under estimate risk.</p>
High Concentration Areas ("Hot Spots")	Over-estimation	Risk in an area is often driven by the elevated concentrations of one or a few samples and is not representative of all situations.

**Table 8-1 Summary of Site-Specific Cleanup Levels
BNSF Mission Wye, Livingston, Montana**

COPC	Soil Direct Contact Cleanup Levels (mg/kg)					Groundwater Cleanup Levels (µg/L)	Site-Specific Leaching Cleanup Levels (mg/kg)
	Commercial/Industrial Worker	Construction/Excavation Worker	Visitor/Trespasser (Adolescent)	Adult Resident	Child Resident	DEQ-7 Standard	
Iron	NA	NA	NA	NA	NA	NA	19,768
Manganese	NA	NA	NA	NA	NA	NA	1,581
Tetrachloroethene	557	739	4077	134	112	5	0.13
Trichloroethene	27	38	222	6.4	5.7	5	0.10

Notes:

COPC = compound of potential concern.

mg/kg = milligrams per kilogram.

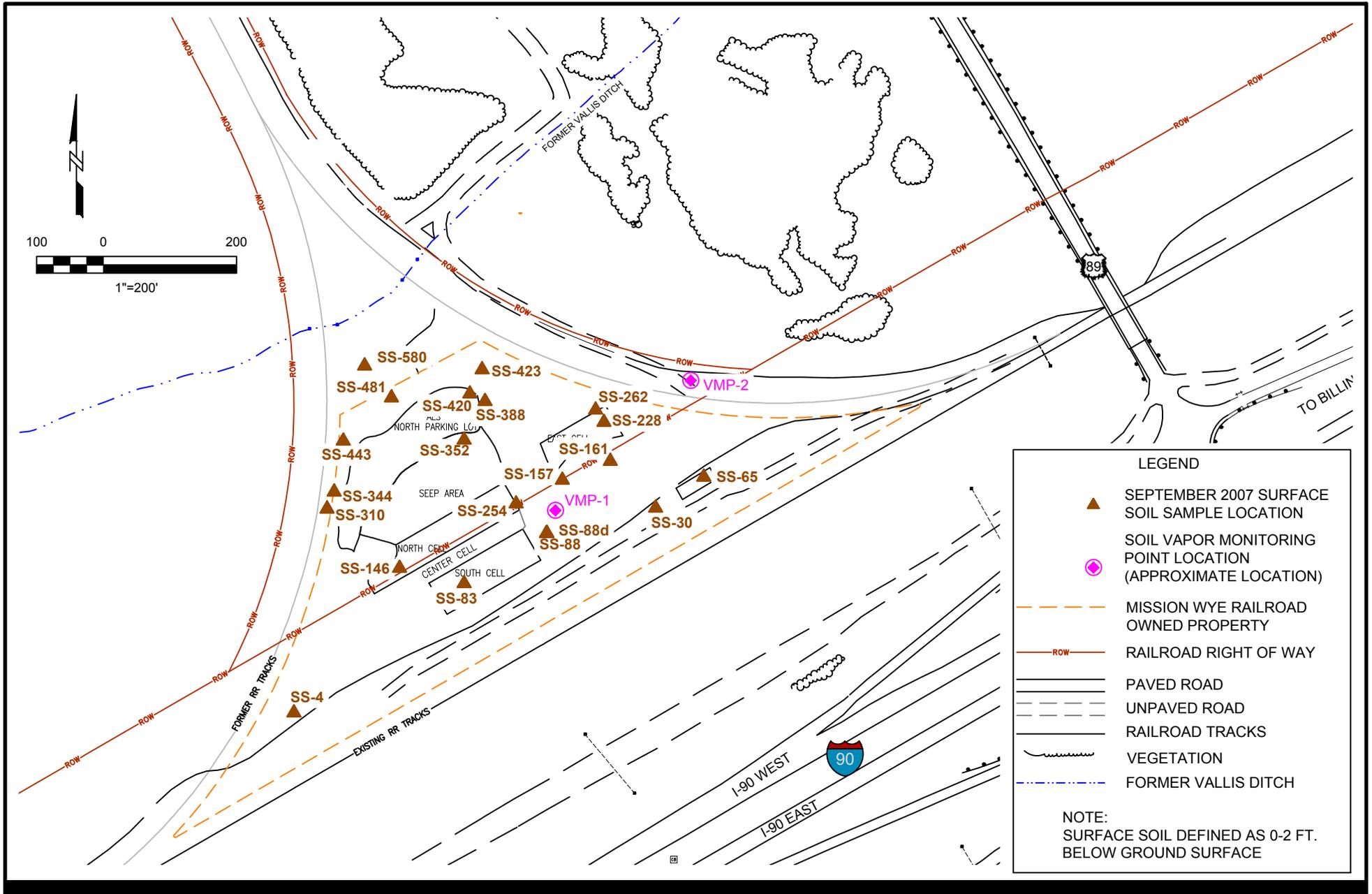
Cleanup levels are based on the lower of the noncancer and cancer value.

Cleanup levels are based on a noncancer hazard index (HI) of 1 and cancer target risk level (TRL) of 1×10^{-5} .

See **Appendix C** for pathway-specific details regarding soil cleanup levels for direct contact.

NA = not applicable; not a COPC for that medium.

Figures



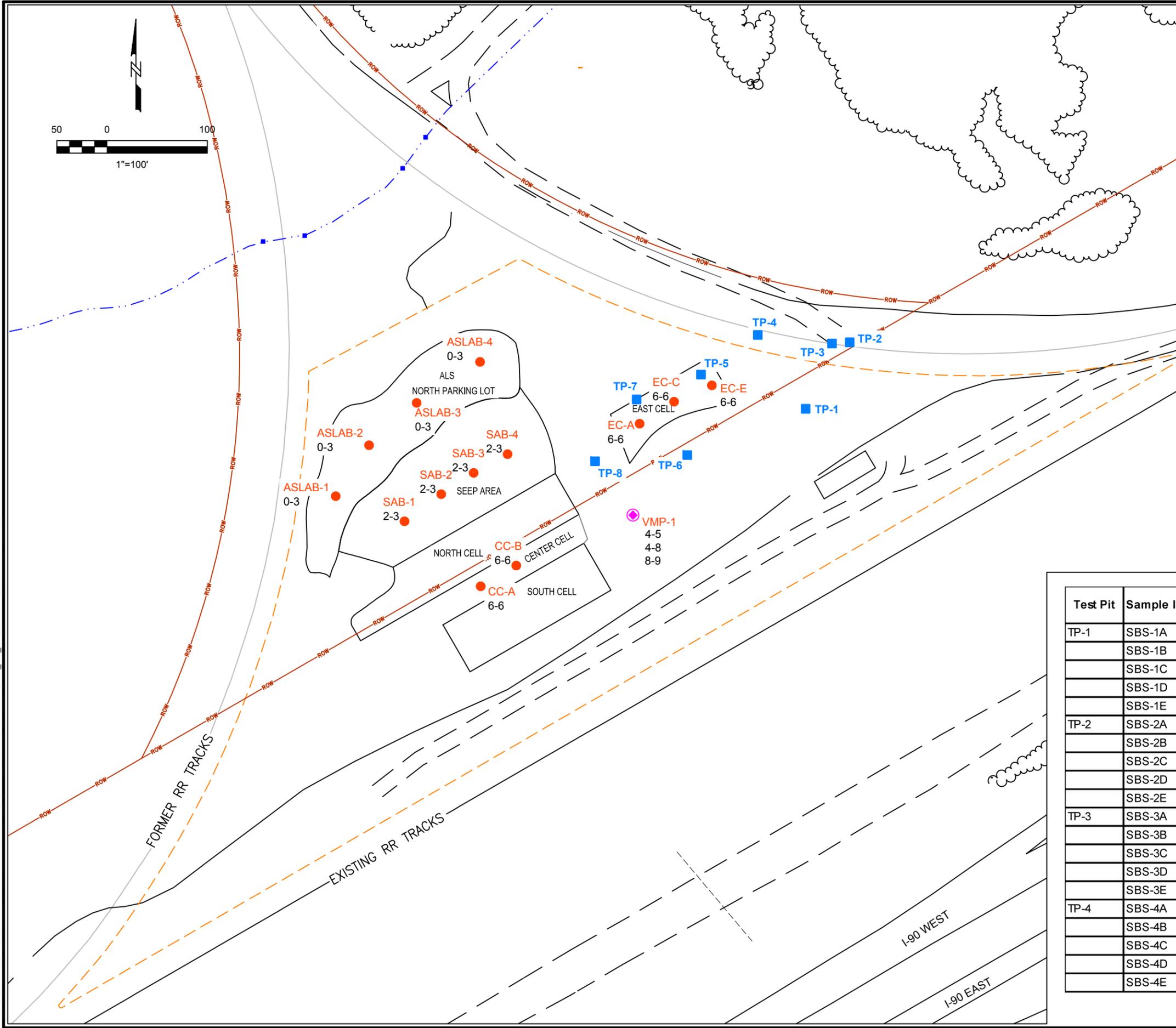
Risk Assessment

BNSF Mission Wye, Livingston, Montana
 Project No.: 60285818 Date: 03/17/14

**SURFACE SOIL SAMPLES USED
 IN THE RISK ASSESSMENT**



Figure: 2-1



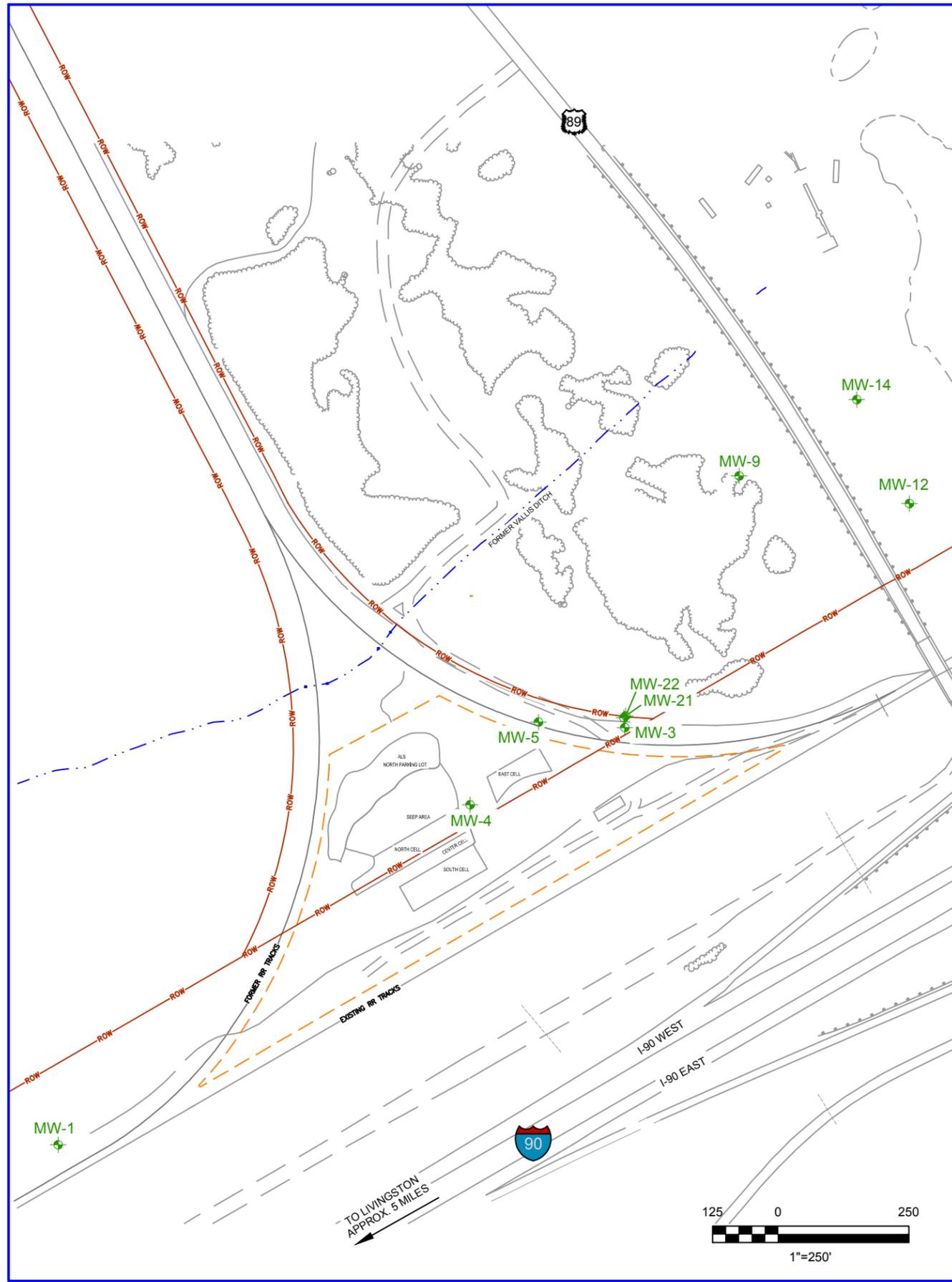
LEGEND

- SEPTEMBER 2007 TEST PIT SAMPLE LOCATION
- SUBSURFACE SOIL SAMPLE LOCATION (APPROXIMATE)
- SOIL VAPOR MONITORING POINT LOCATION (APPROXIMATE LOCATION)
- 2-3 SAMPLE DEPTH (FT. BGS)
- MISSION WYE RAILROAD OWNED PROPERTY
- RAILROAD RIGHT OF WAY
- PAVED ROAD
- UNPAVED ROAD
- RAILROAD TRACKS
- VEGETATION
- FORMER VALLIS DITCH

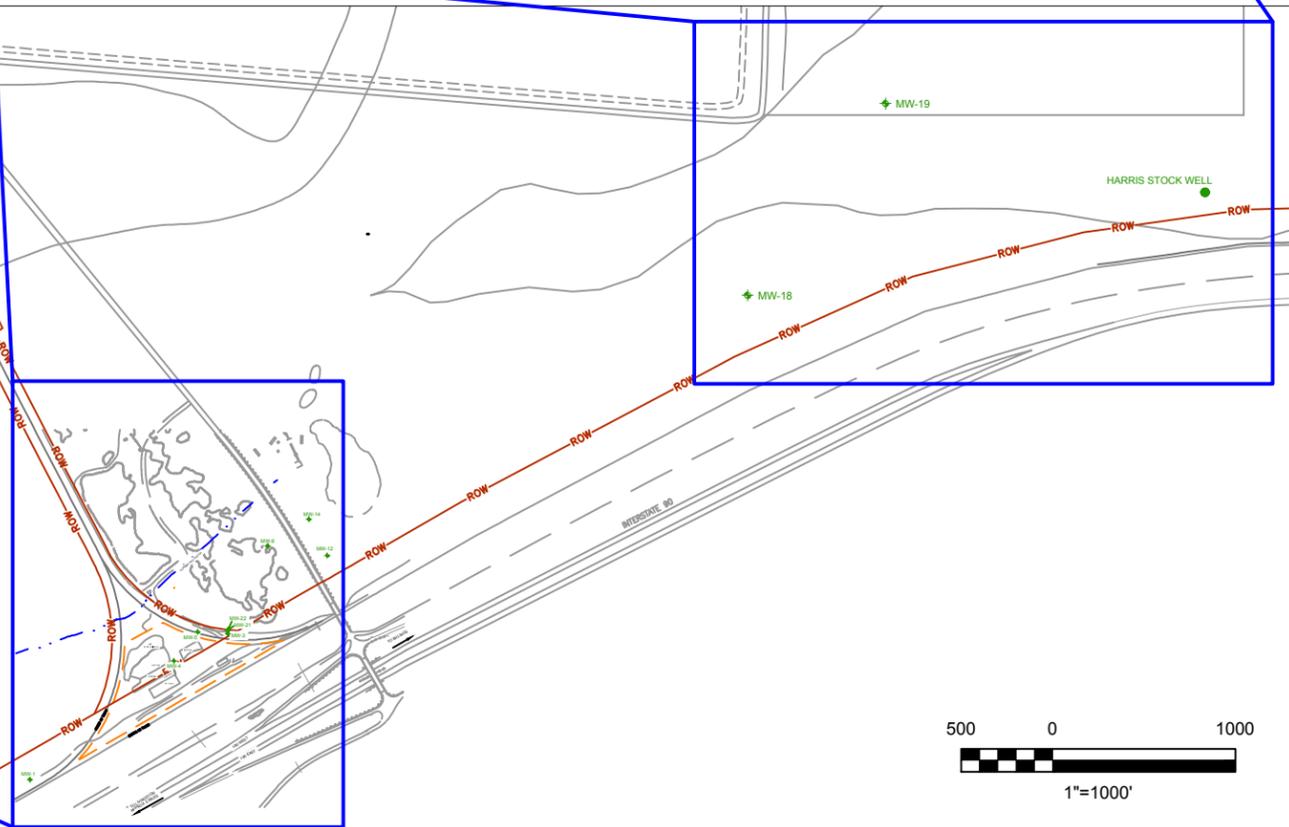
- NOTES:**
- SAMPLES FROM TEST PIT 1 (TP-1) WERE LABELED AS SBS-1. REFER TO TABLE BELOW FOR SAMPLE DEPTHS.
 - SUBSURFACE SOIL INCLUDES SAMPLES COLLECTED > 2 FT. BGS (BELOW GROUND SURFACE)
 - SAMPLE DESIGNATIONS REFER TO WHERE SAMPLE WAS COLLECTED IN TEST PIT.

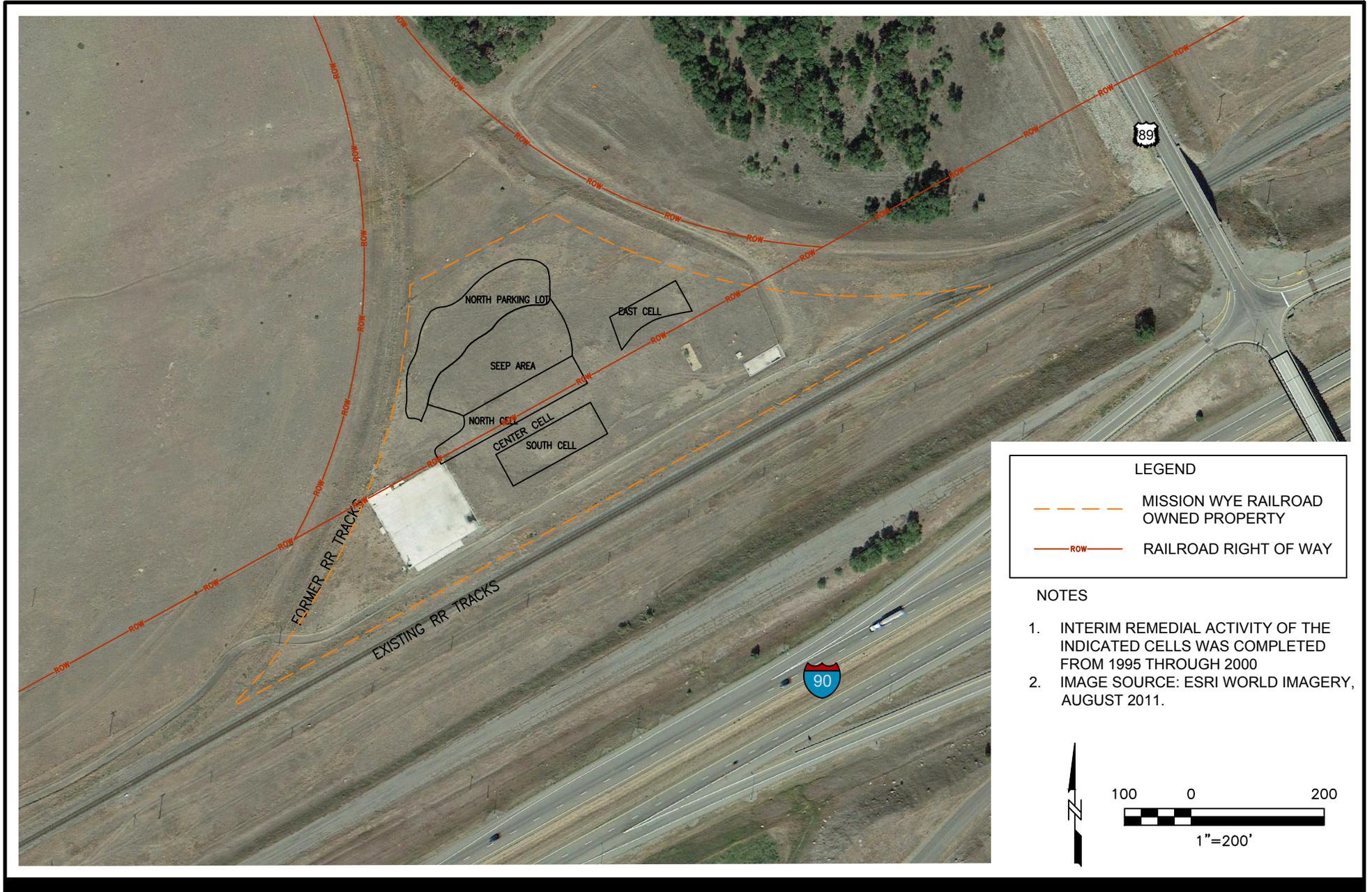
A = NORTH WALL	D=WEST WALL
B = EAST WALL	E = BOTTOM OF PIT
C=SOUTH WALL	

Test Pit	Sample ID	Sample Depth feet bgs	Test Pit	Sample ID	Sample Depth feet bgs
TP-1	SBS-1A	7	TP-5	SBS-5A	5-6
	SBS-1B	7		SBS-5B	6
	SBS-1C	7		SBS-5C	5
	SBS-1D	6		SBS-5D	5
	SBS-1E	8.5		SBS-5E	8
TP-2	SBS-2A	7	TP-6	SBS-6A	6.5
	SBS-2B	6.5		SBS-6B	7
	SBS-2C	4-6		SBS-6C	7
	SBS-2D	7.5		SBS-6D	6
	SBS-2E	9		SBS-6E	8
TP-3	SBS-3A	7	TP-7	SBS-7A	6
	SBS-3B	6.5		SBS-7B	7
	SBS-3C	5.5		SBS-7C	7
	SBS-3D	6.5		SBS-7D	2
	SBS-3E	8.5		SBS-7E	9
TP-4	SBS-4A	6.5	TP-8	SBS-8A	5.5
	SBS-4B	6.5		SBS-8B	6
	SBS-4C	6.5		SBS-8C	7
	SBS-4D	6.5		SBS-8D	6
	SBS-4E	8.5		SBS-8E	8



LEGEND	
	MONITORING WELL
	MISSION WYE RAILROAD OWNED PROPERTY
	RAILROAD RIGHT OF WAY
	PAVED ROAD
	UNPAVED ROAD
	RAILROAD TRACKS
	VEGETATION
	FORMER VALLIS DITCH





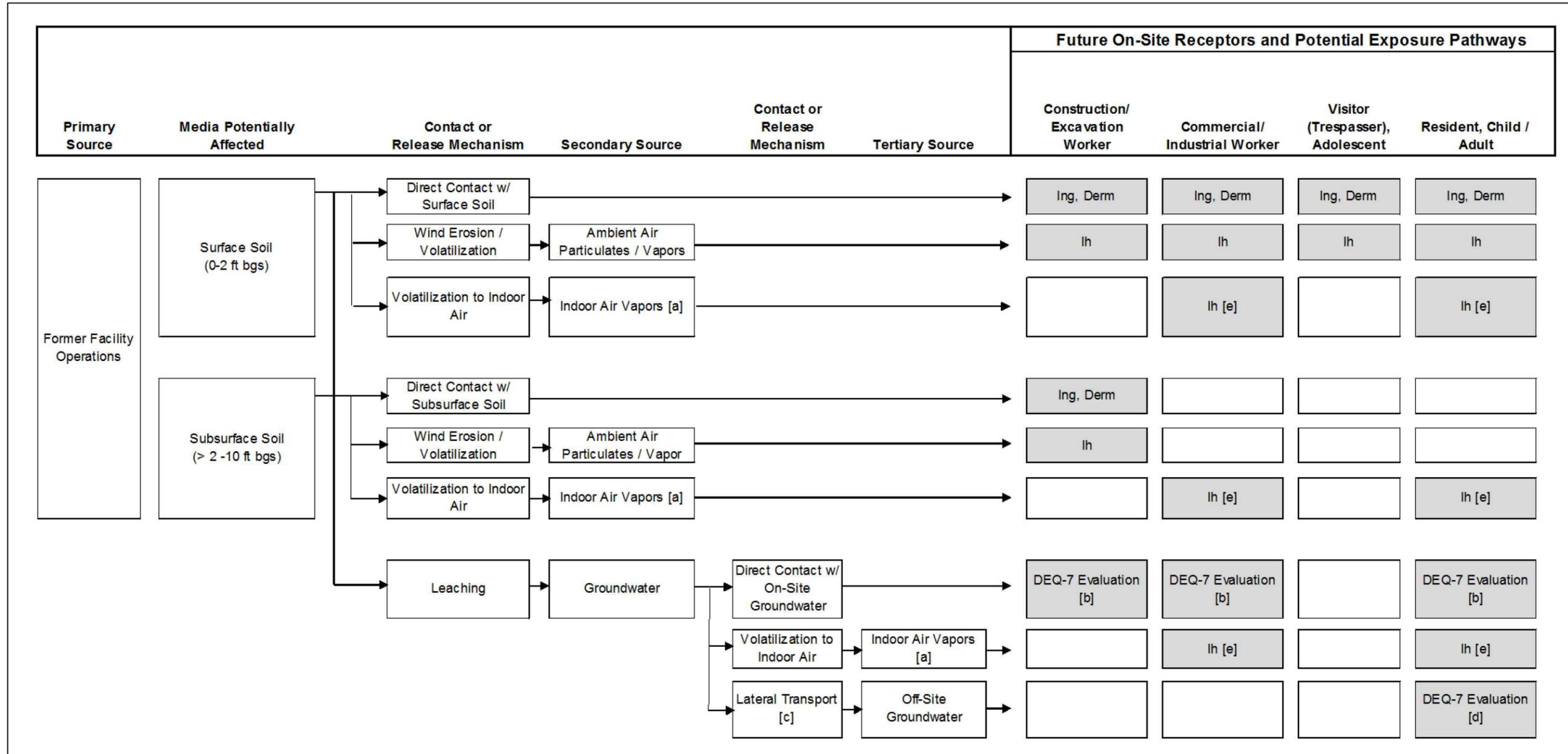
Risk Assessment

BNSF Mission Wye, Livingston, Montana
Project No.: 60285818 Date: 03/17/14

MISSION WYE LAYOUT



Figure: 3-1

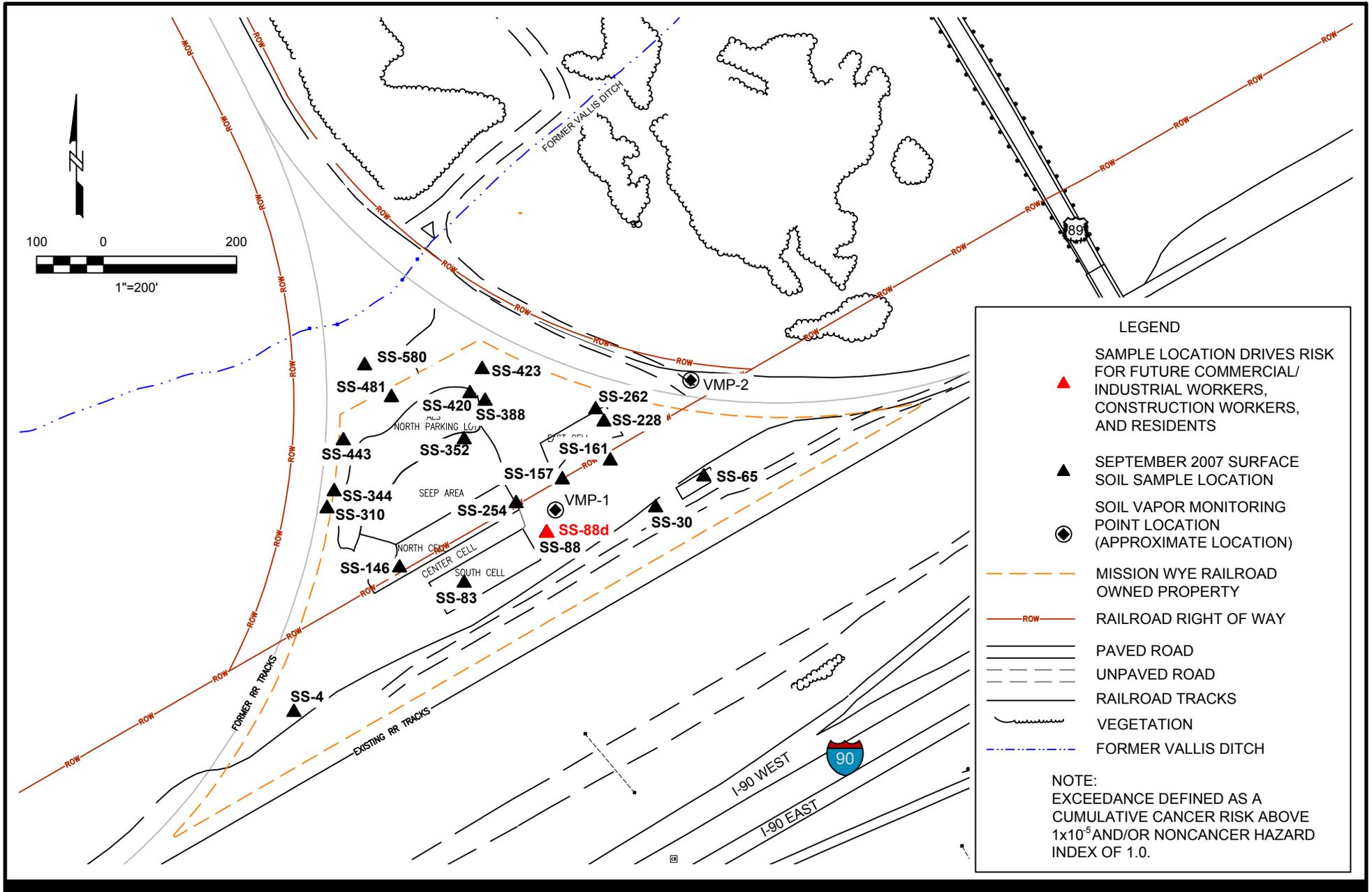


Notes:

- [a] Under current conditions, the vapor intrusion pathway is incomplete as no occupied buildings are present at the Facility. The potential for vapor intrusion into future buildings was evaluated in accordance with the Soil Vapor Monitoring Plan approved by DEQ. The results of the vapor intrusion monitoring are presented in the "Soil Vapor Monitoring and Vapor Intrusion Evaluation Report" and are summarized in the risk assessment (AECOM 2013).
 - [b] Site-specific receptor risks and cleanup levels for groundwater were not calculated in the risk assessment. Instead, groundwater data was compared to DEQ-7 standards and exceedances reported as requested by DEQ.
 - [c] Existing downgradient domestic wells indicate no evidence of impacts.
 - [d] Clean-up to DEQ-7 standards on the Facility is protective of potential future off-site groundwater use.
- bgs = below ground surface
 [e] = While currently no vapor intrusion pathways exist, future development of the facility may result in completed pathways.

Legend:

- Ing = Ingestion
- Derm = Dermal contact
- Ih = Inhalation
- Blank = incomplete exposure pathway not evaluated in the risk assessment
- Shading = complete exposure pathway to be evaluated quantitatively in the risk assessment



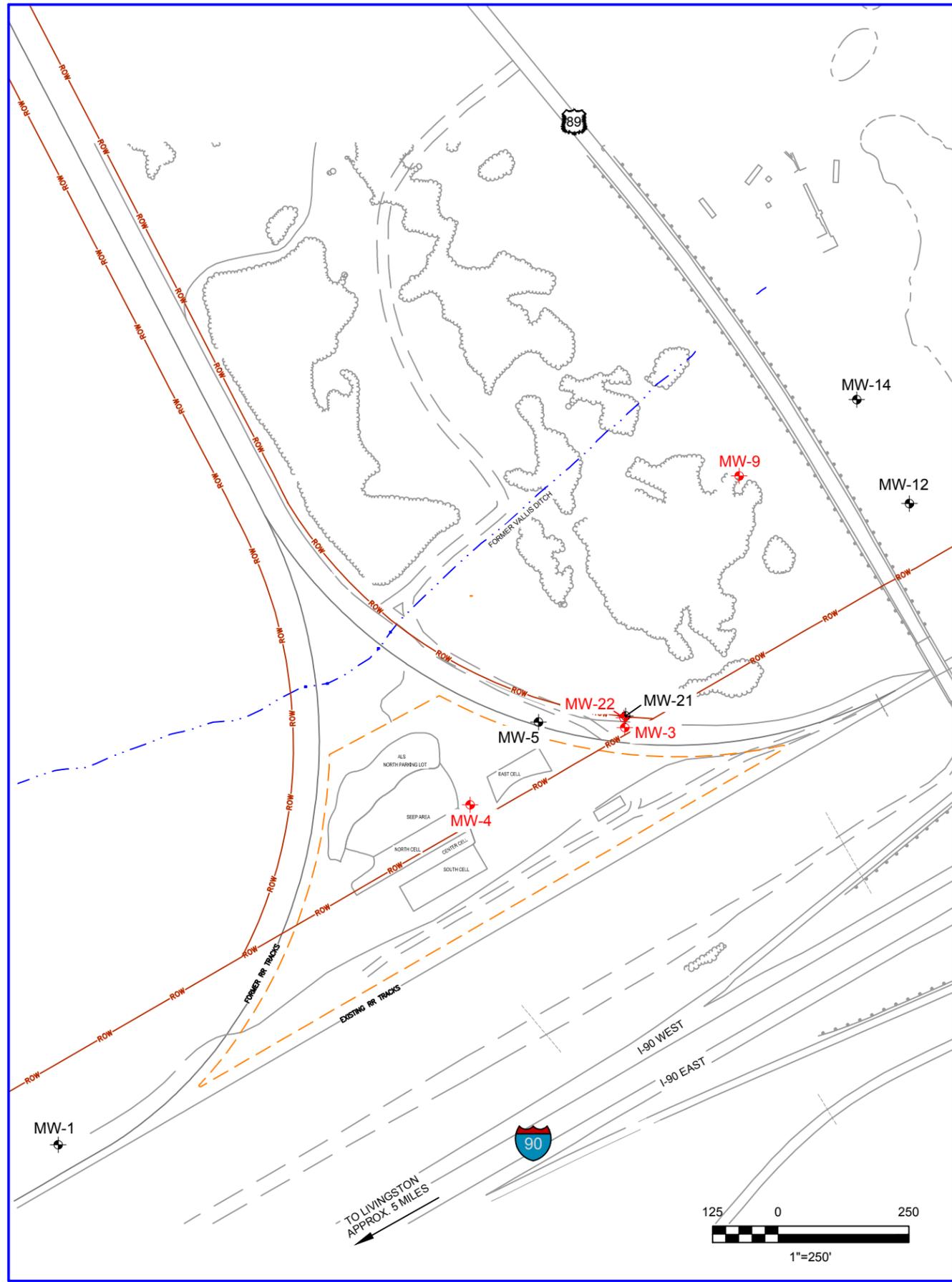
Risk Assessment

BNSF Mission Wye, Livingston, Montana
 Project No.: 60285818 Date: 03/17/14

**SOIL LOCATION(S) DRIVING EXCEEDANCES
 OF ACCEPTABLE RISK LEVELS**



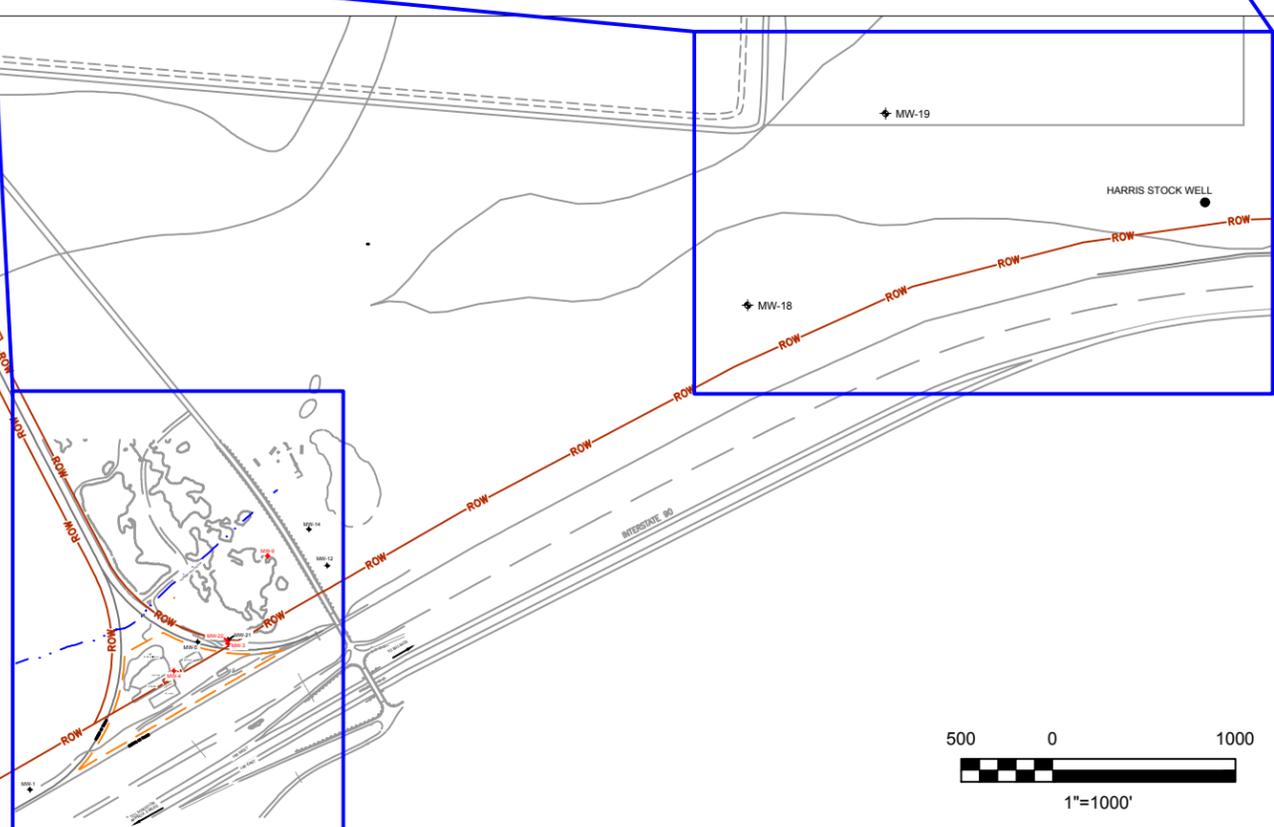
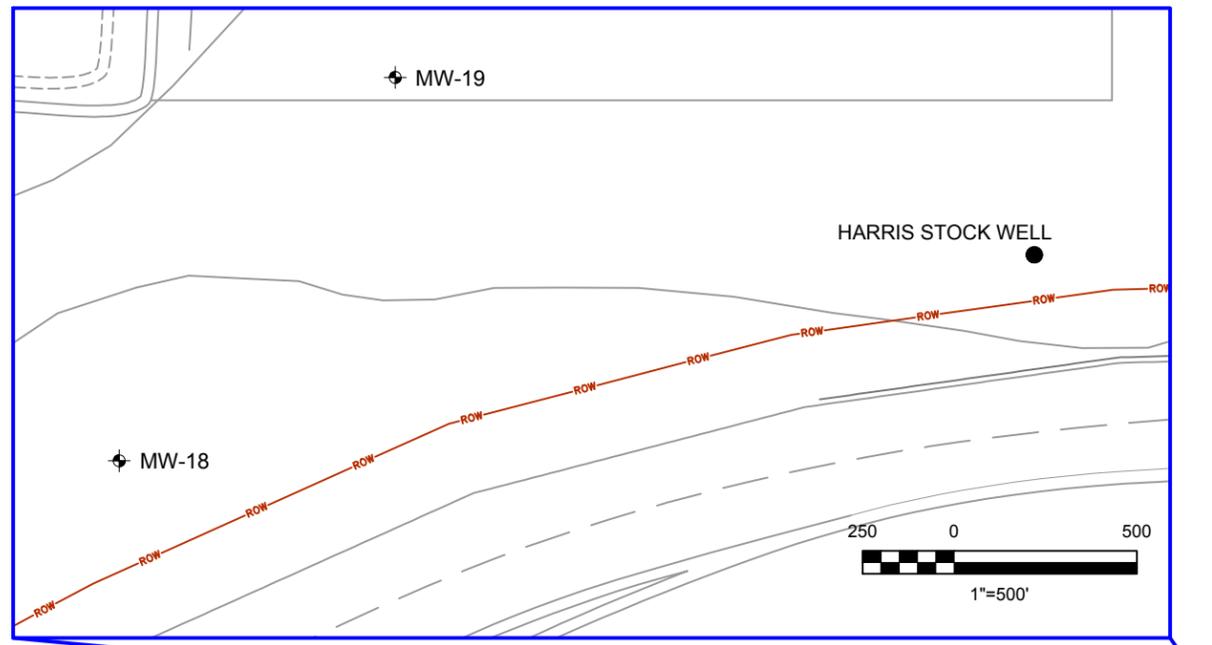
Figure: 6-1

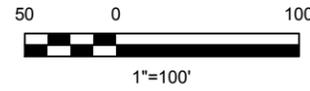
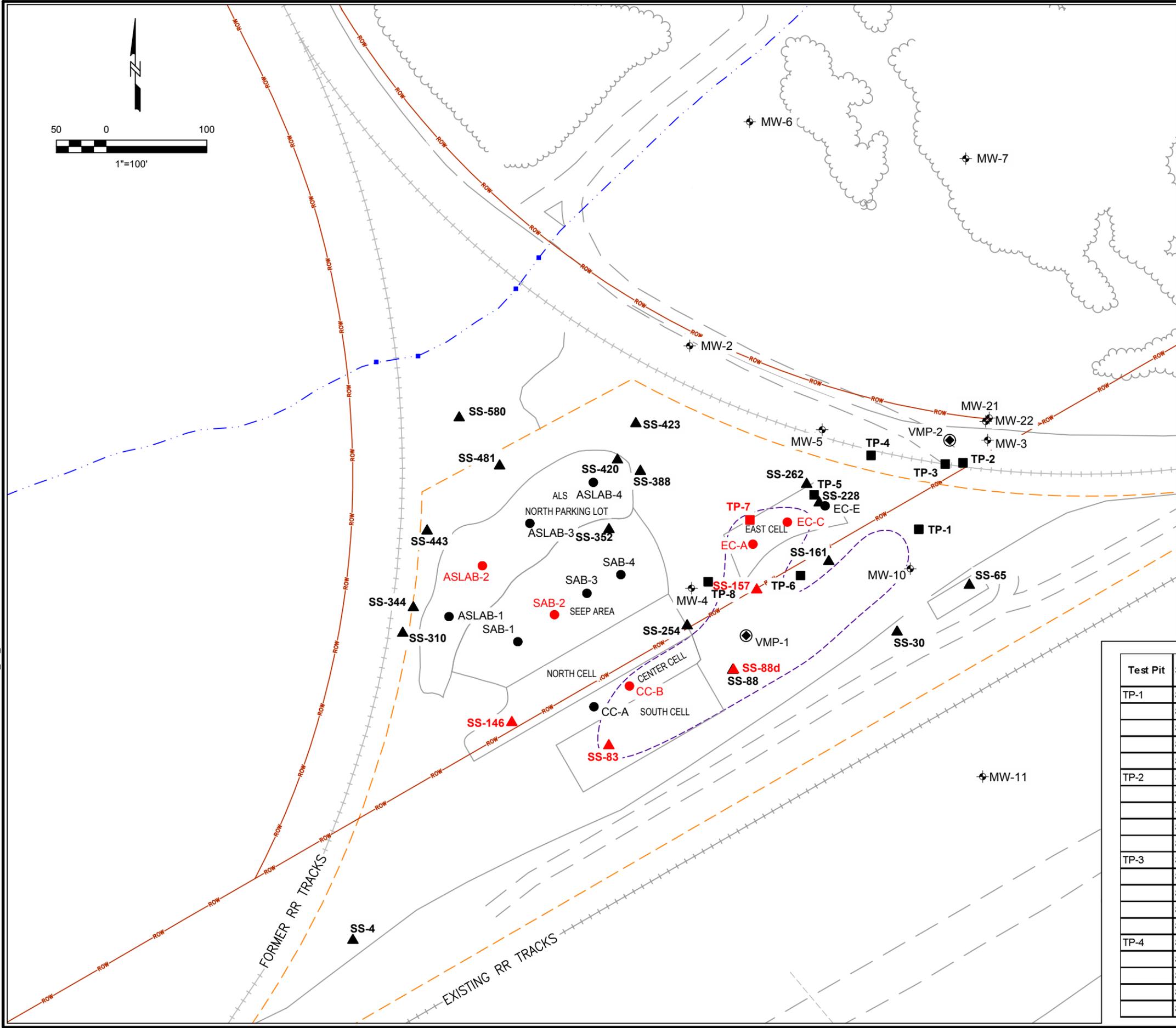


LEGEND

	MONITORING WELL WITH CONCENTRATIONS OF GROUNDWATER COPC ABOVE DEQ-7 STANDARDS		PAVED ROAD
	MONITORING WELL BELOW DEQ-7 STANDARDS		UNPAVED ROAD
	MISSION WYE RAILROAD OWNED PROPERTY		RAILROAD TRACKS
	RAILROAD RIGHT OF WAY		VEGETATION
			FORMER VALLIS DITCH

NOTE: INCLUDES GROUNDWATER DATA COLLECTED BETWEEN 2010 AND 2013.





LEGEND

- ● ▲ EXCEEDS LEACHING CLEANUP LEVEL
- SEPTEMBER 2007 TEST PIT SAMPLE LOCATION
- ▲ SEPTEMBER 2007 SURFACE SOIL SAMPLE LOCATION
- SUBSURFACE SOIL SAMPLE (APPROXIMATE LOCATION)
- ⊙ SOIL VAPOR MONITORING POINT LOCATION (APPROXIMATE LOCATION)
- ⊕ MONITORING WELL
- MISSION WYE RAILROAD OWNED PROPERTY
- ROW RAILROAD RIGHT OF WAY
- PAVED ROAD
- - - UNPAVED ROAD
- RAILROAD TRACKS
- ~ VEGETATION
- · - · - FORMER VALLIS DITCH
- - - - - AREA POTENTIALLY POSING A LEACHING TO GROUNDWATER RISK

- NOTES:**
- SAMPLES FROM TEST PIT 1 (TP-1) WERE LABELED AS SBS-1. REFER TO TABLE BELOW FOR SAMPLE DEPTHS.
 - RESULTS SHOWN FOR PCE AND TCE ONLY, IRON EXCEEDANCES NOT INCLUDED.
 - SAMPLE DESIGNATIONS REFER TO WHERE SAMPLE WAS COLLECTED IN TEST PIT.
 A = NORTH WALL D=WEST WALL
 B = EAST WALL E= BOTTOM OF PIT
 C=SOUTH WALL

Test Pit	Sample ID	Sample Depth feet bgs	Test Pit	Sample ID	Sample Depth feet bgs
TP-1	SBS-1A	7	TP-5	SBS-5A	5-6
	SBS-1B	7		SBS-5B	6
	SBS-1C	7		SBS-5C	5
	SBS-1D	6		SBS-5D	5
	SBS-1E	8.5		SBS-5E	8
TP-2	SBS-2A	7	TP-6	SBS-6A	6.5
	SBS-2B	6.5		SBS-6B	7
	SBS-2C	4-6		SBS-6C	7
	SBS-2D	7.5		SBS-6D	6
	SBS-2E	9		SBS-6E	8
TP-3	SBS-3A	7	TP-7	SBS-7A	6
	SBS-3B	6.5		SBS-7B	7
	SBS-3C	5.5		SBS-7C	7
	SBS-3D	6.5		SBS-7D	2
	SBS-3E	8.5		SBS-7E	9
TP-4	SBS-4A	6.5	TP-8	SBS-8A	5.5
	SBS-4B	6.5		SBS-8B	6
	SBS-4C	6.5		SBS-8C	7
	SBS-4D	6.5		SBS-8D	6
	SBS-4E	8.5		SBS-8E	8

Appendix A

Analytical Datasets Used in the Risk Assessment

**Table A-1 Summary of Analytical Surface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SS-146	SS-157	SS-161	SS-228	SS-254	SS-262
			9/13/2007 3:20:00 PM N 0.42-0.99 ft	9/13/2007 4:20:00 PM N 0.66-1.24 ft	9/13/2007 4:16:00 PM N 0.66-0.99 ft	9/13/2007 5:08:00 PM N 0.74-1.49 ft	9/13/2007 3:49:00 PM N 0.33-1.16 ft	9/13/2007 4:51:00 PM N 0.50-0.99 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
1-Chlorohexane	544-10-5	mg/kg	< 0.831	< 0.838	< 0.868	< 0.841	< 0.829	< 0.840
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
2-Butanone	78-93-3	mg/kg	< 0.831	< 0.838	< 0.868	< 0.841	< 0.829	< 0.840
2-Chlorotoluene	95-49-8	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
2-Hexanone	591-78-6	mg/kg	< 0.831	< 0.838	< 0.868	< 0.841	< 0.829	< 0.840
4-Chlorotoluene	106-43-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.831	< 0.838	< 0.868	< 0.841	< 0.829	< 0.840
Acetone	67-64-1	mg/kg	< 0.831	< 0.838	< 0.868	< 0.841	< 0.829	< 0.840
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Bromobenzene	108-86-1	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Bromochloromethane	74-97-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Bromodichloromethane	75-27-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Bromoform	75-25-2	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Bromomethane	74-83-9	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
C11-C22 Aromatics	C11-C22 ARO	mg/kg	156	203	154	80.6	85.2	4.55
C19-C36 Aliphatics	C19-C36 ALIP	mg/kg	404	536	338	231	230	12.7
C5-C8 Aliphatics	C5-C8 ALIP	mg/kg	< 2.07	< 2.10	< 2.17	< 2.10	< 2.07	< 2.10
C5-C8 Aliphatics, adjusted	C5-C8 ALIPADJ	mg/kg	< 2.07	< 2.10	< 2.17	< 2.10	< 2.07	< 2.10
C9-C10 Aromatics	C9-C10 ARO	mg/kg	< 2.07	< 2.10	< 2.17	< 2.10	< 2.07	< 2.10
C9-C12 Aliphatics	C9-C12 ALIP	mg/kg	< 2.07	< 2.10	< 2.17	< 2.10	< 2.07	< 2.10
C9-C12 Aliphatics, adjusted	C9-C12 ALIPADJ	mg/kg	< 2.07	< 2.10	< 2.17	< 2.10	< 2.07	< 2.10
C9-C18 Aliphatics	C9-C18 ALIP	mg/kg	< 42.1	< 41.4	< 43.5	< 21.1	< 21.2	< 20.8
Carbon disulfide	75-15-0	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Carbon tetrachloride	56-23-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Chlorobenzene	108-90-7	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Chloroethane	75-00-3	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Chloroform	67-66-3	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Chloromethane	74-87-3	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Dibromochloromethane	124-48-1	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Dibromomethane	74-95-3	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	96.4	95.3	91.7	95	96	94.7
Ethylbenzene	100-41-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Extractable Petroleum Hydrocarbons, Total	EPH	mg/kg	562	744	494	314	316	17.5
Hexachlorobutadiene	87-68-3	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
Isopropylbenzene	98-82-8	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
m,p-Xylenes	MP-XYL	mg/kg	< 0.166	< 0.168	< 0.174	< 0.168	< 0.166	< 0.168
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
Methylene chloride	75-09-2	mg/kg	< 0.831	< 0.838	< 0.868	< 0.841	< 0.829	< 0.840
Naphthalene	91-20-3	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
n-Butylbenzene	104-51-8	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
n-Hexane	110-54-3	mg/kg	< 0.415	< 0.419	< 0.434	< 0.421	< 0.415	< 0.420
n-Propylbenzene	103-65-1	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
o-Xylene	95-47-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Styrene	100-42-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
tert-Butylbenzene	98-06-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Tetrachloroethene	127-18-4	mg/kg	0.133	0.223	0.0451	0.119	0.0846	< 0.0840
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrdp	mg/kg	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Trichloroethene	79-01-6	mg/kg	0.0266	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Vinyl chloride	75-01-4	mg/kg	< 0.0831	< 0.0838	< 0.0868	< 0.0841	< 0.0829	< 0.0840
Volatile Petroleum Hydrocarbons, Total	VPH	mg/kg	< 4.14	< 4.19	< 4.34	< 4.21	< 4.15	< 4.20
Xylenes, total	1330-20-7	mg/kg	< 0.249	< 0.251	< 0.260	< 0.252	< 0.249	< 0.252

Notes:
Surface soil data (0-2 ft bgs)
Bold indicates detected concentration
< = analyte not detected
mg/kg = milligram per kilogram
NA = Not Analyzed

**Table A-1 Summary of Analytical Surface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SS-30	SS-310	SS-344	SS-352	SS-388	SS-4
			9/13/2007 4:40:00 PM N 0.41-0.83 ft	9/13/2007 10:30:00 AM N 0.50-1.49 ft	9/13/2007 10:45:00 AM N 0.25-0.99 ft	9/13/2007 12:22:00 PM N 0.66-1.82 ft	9/13/2007 12:04:00 PM N 0.33-0.66 ft	9/13/2007 9:31:00 AM N 0.66-0.99 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,1,1,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
1-Chlorohexane	544-10-5	mg/kg	< 0.855	< 0.844	< 0.872	< 0.818	< 0.873	< 0.917
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
2-Butanone	78-93-3	mg/kg	< 0.855	< 0.844	< 0.872	< 0.818	< 0.873	< 0.917
2-Chlorotoluene	95-49-8	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
2-Hexanone	591-78-6	mg/kg	< 0.855	< 0.844	< 0.872	< 0.818	< 0.873	< 0.917
4-Chlorotoluene	106-43-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.855	< 0.844	< 0.872	< 0.818	< 0.873	< 0.917
Acetone	67-64-1	mg/kg	< 0.855	< 0.844	< 0.872	< 0.818	< 0.873	< 0.917
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Bromobenzene	108-86-1	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Bromochloromethane	74-97-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Bromodichloromethane	75-27-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Bromoform	75-25-2	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Bromomethane	74-83-9	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
C11-C22 Aromatics	C11-C22 ARO	mg/kg	26.1	204	71	90.7	12.1	< 23.0
C19-C36 Aliphatics	C19-C36 ALIP	mg/kg	52.3	562	208	276	32	9.57
C5-C8 Aliphatics	C5-C8 ALIP	mg/kg	< 2.14	< 2.11	< 2.18	< 2.04	< 2.19	< 2.29
C5-C8 Aliphatics, adjusted	C5-C8 ALIPADJ	mg/kg	< 2.14	< 2.11	< 2.18	< 2.04	< 2.19	< 2.29
C9-C10 Aromatics	C9-C10 ARO	mg/kg	< 2.14	< 2.11	< 2.18	< 2.04	< 2.19	< 2.29
C9-C12 Aliphatics	C9-C12 ALIP	mg/kg	< 2.14	< 2.11	< 2.18	< 2.04	< 2.19	< 2.29
C9-C12 Aliphatics, adjusted	C9-C12 ALIPADJ	mg/kg	< 2.14	< 2.11	< 2.18	< 2.04	< 2.19	< 2.29
C9-C18 Aliphatics	C9-C18 ALIP	mg/kg	< 21.4	< 41.9	< 22.1	< 20.4	< 22.1	< 23.0
Carbon disulfide	75-15-0	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Carbon tetrachloride	56-23-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Chlorobenzene	108-90-7	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Chloroethane	75-00-3	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Chloroform	67-66-3	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Chloromethane	74-87-3	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Dibromochloromethane	124-48-1	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Dibromomethane	74-95-3	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	93.6	94.9	91.6	97.6	91.4	87.7
Ethylbenzene	100-41-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Extractable Petroleum Hydrocarbons, Total	EPH	mg/kg	78.7	770	280	369	44.3	12
Hexachlorobutadiene	87-68-3	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
Isopropylbenzene	98-82-8	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
m,p-Xylenes	MP-XYL	mg/kg	< 0.171	< 0.169	< 0.174	< 0.164	< 0.175	0.0238
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
Methylene chloride	75-09-2	mg/kg	< 0.855	< 0.844	< 0.872	< 0.818	< 0.873	< 0.917
Naphthalene	91-20-3	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
n-Butylbenzene	104-51-8	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
n-Hexane	110-54-3	mg/kg	< 0.427	< 0.422	< 0.436	< 0.409	< 0.437	< 0.459
n-Propylbenzene	103-65-1	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
o-Xylene	95-47-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Styrene	100-42-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
tert-Butylbenzene	98-06-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Tetrachloroethene	127-18-4	mg/kg	< 0.0855	0.115	0.068	< 0.0818	< 0.0873	< 0.0917
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Trichloroethene	79-01-6	mg/kg	< 0.0855	0.0262	0.0358	< 0.0818	< 0.0873	< 0.0917
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Vinyl chloride	75-01-4	mg/kg	< 0.0855	< 0.0844	< 0.0872	< 0.0818	< 0.0873	< 0.0917
Volatile Petroleum Hydrocarbons, Total	VPH	mg/kg	< 4.27	< 4.22	< 4.36	< 4.08	< 4.37	< 4.59
Xylenes, total	1330-20-7	mg/kg	< 0.256	< 0.253	< 0.262	< 0.245	< 0.262	0.0238

Notes:
 Surface soil data (0-2 ft bgs)
Bold indicates detected concentration
 < = analyte not detected
 mg/kg = milligram per kilogram
 NA = Not Analyzed

Table A-1 Summary of Analytical Surface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	SS-420	SS-423	SS-443	SS-481	SS-580	SS-65
			9/13/2007 11:57:00 AM N 0.33-1.16 ft	9/13/2007 12:22:00 PM N 0.50-0.99 ft	9/13/2007 11:04:00 AM N 0.25-0.83 ft	9/13/2007 11:11:00 AM N 0.50-1.24 ft	9/13/2007 12:40:00 PM N 0.33-0.74 ft	9/13/2007 4:33:00 PM N 0.99-0.99 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0847	0.0304	0.0218	< 0.0870	< 0.0896	< 0.0871
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
1-Chlorohexane	544-10-5	mg/kg	< 0.847	< 0.845	< 0.871	< 0.870	< 0.896	< 0.871
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
2-Butanone	78-93-3	mg/kg	< 0.847	< 0.845	< 0.871	< 0.870	< 0.896	< 0.871
2-Chlorotoluene	95-49-8	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
2-Hexanone	591-78-6	mg/kg	< 0.847	< 0.845	< 0.871	< 0.870	< 0.896	< 0.871
4-Chlorotoluene	106-43-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.847	< 0.845	< 0.871	< 0.870	< 0.896	< 0.871
Acetone	67-64-1	mg/kg	< 0.847	< 0.845	< 0.871	< 0.870	< 0.896	< 0.871
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Bromobenzene	108-86-1	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Bromochloromethane	74-97-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Bromodichloromethane	75-27-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Bromoform	75-25-2	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Bromomethane	74-83-9	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
C11-C22 Aromatics	C11-C22 ARO	mg/kg	5.24	6.7	3.43	65.4	< 22.6	11.5
C19-C36 Aliphatics	C19-C36 ALIP	mg/kg	35.2	< 20.8	11.6	140	< 22.6	43.9
C5-C8 Aliphatics	C5-C8 ALIP	mg/kg	< 2.12	< 2.11	< 2.18	< 2.18	< 2.24	< 2.18
C5-C8 Aliphatics, adjusted	C5-C8 ALIPADJ	mg/kg	< 2.12	< 2.11	< 2.18	< 2.18	< 2.24	< 2.18
C9-C10 Aromatics	C9-C10 ARO	mg/kg	< 2.12	< 2.11	< 2.18	< 2.18	< 2.24	< 2.18
C9-C12 Aliphatics	C9-C12 ALIP	mg/kg	< 2.12	< 2.11	< 2.18	< 2.18	< 2.24	< 2.18
C9-C12 Aliphatics, adjusted	C9-C12 ALIPADJ	mg/kg	< 2.12	< 2.11	< 2.18	< 2.18	< 2.24	< 2.18
C9-C18 Aliphatics	C9-C18 ALIP	mg/kg	< 21.1	< 20.8	< 21.5	< 21.4	< 22.6	< 21.4
Carbon disulfide	75-15-0	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Carbon tetrachloride	56-23-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Chlorobenzene	108-90-7	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Chloroethane	75-00-3	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Chloroform	67-66-3	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Chloromethane	74-87-3	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Dibromochloromethane	124-48-1	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Dibromomethane	74-95-3	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	94	94.8	91.5	91.9	89.4	92.2
Ethylbenzene	100-41-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Extractable Petroleum Hydrocarbons, Total	EPH	mg/kg	40.7	6.2	15.3	206	< 67.8	55.5
Hexachlorobutadiene	87-68-3	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
Isopropylbenzene	98-82-8	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
m,p-Xylenes	MP-XYL	mg/kg	< 0.169	< 0.169	< 0.174	< 0.174	< 0.179	< 0.174
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
Methylene chloride	75-09-2	mg/kg	< 0.847	< 0.845	< 0.871	< 0.870	< 0.896	< 0.871
Naphthalene	91-20-3	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
n-Butylbenzene	104-51-8	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
n-Hexane	110-54-3	mg/kg	< 0.423	< 0.423	< 0.435	< 0.435	< 0.448	< 0.435
n-Propylbenzene	103-65-1	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
o-Xylene	95-47-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Styrene	100-42-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
tert-Butylbenzene	98-06-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Tetrachloroethene	127-18-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Trichloroethene	79-01-6	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Vinyl chloride	75-01-4	mg/kg	< 0.0847	< 0.0845	< 0.0871	< 0.0870	< 0.0896	< 0.0871
Volatile Petroleum Hydrocarbons, Total	VPH	mg/kg	< 4.23	< 4.23	< 4.36	< 4.35	< 4.48	< 4.35
Xylenes, total	1330-20-7	mg/kg	< 0.254	< 0.254	< 0.261	< 0.261	< 0.269	< 0.261

Notes:
Surface soil data (0-2 ft bgs)
Bold indicates detected concentration
< = analyte not detected
mg/kg = milligram per kilogram
NA = Not Analyzed

**Table A-1 Summary of Analytical Surface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SS-83	SS-88	SS-88d	VMP-1D	VMP-2D	VMP-2D
			9/13/2007 2:52:00 PM N 0.33-0.83 ft	9/13/2007 3:00:00 PM N 0.25-0.99 ft	9/13/2007 3:34:00 PM N 1.23-1.34 ft	(0.5-1.5') AM N 0.5-1.5 ft	(0.5-1.3') PM N 0.5-1.3 ft	(0.9-1.3') PM N 0.9-1.3 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	< 0.0537	NA	< 0.0571
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.412	< 0.419	< 17.4	< 0.0537	NA	< 0.0571
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.215	NA	< 0.228
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.412	< 0.419	< 17.4	< 0.0537	NA	< 0.0571
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.412	< 0.419	< 17.4	< 0.215	NA	< 0.228
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
1-Chlorohexane	544-10-5	mg/kg	< 0.825	< 0.838	< 34.8	NA	NA	NA
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.215	NA	< 0.228
2-Butanone	78-93-3	mg/kg	< 0.825	< 0.838	< 34.8	< 0.268	NA	< 0.285
2-Chlorotoluene	95-49-8	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
2-Hexanone	591-78-6	mg/kg	< 0.825	< 0.838	< 34.8	NA	NA	NA
4-Chlorotoluene	106-43-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.825	< 0.838	< 34.8	< 0.268	NA	< 0.285
Acetone	67-64-1	mg/kg	< 0.825	< 0.838	< 34.8	< 1.07	NA	< 1.14
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	< 0.215	NA	< 0.228
Benzene	71-43-2	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0215	NA	< 0.0228
Bromobenzene	108-86-1	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Bromochloromethane	74-97-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Bromodichloromethane	75-27-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Bromoform	75-25-2	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.215	NA	< 0.228
Bromomethane	74-83-9	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.537	NA	< 0.571
C11-C22 Aromatics	C11-C22 ARO	mg/kg	219	111	143	NA	NA	NA
C19-C36 Aliphatics	C19-C36 ALIP	mg/kg	537	246	306	NA	NA	NA
C5-C8 Aliphatics	C5-C8 ALIP	mg/kg	< 2.06	< 2.10	30.1	NA	NA	NA
C5-C8 Aliphatics, adjusted	C5-C8 ALIPADJ	mg/kg	< 2.06	< 2.10	30	NA	NA	NA
C9-C10 Aromatics	C9-C10 ARO	mg/kg	< 2.06	< 2.10	0.581	NA	NA	NA
C9-C12 Aliphatics	C9-C12 ALIP	mg/kg	< 2.06	< 2.10	< 2.34	NA	NA	NA
C9-C12 Aliphatics, adjusted	C9-C12 ALIPADJ	mg/kg	< 2.06	< 2.10	< 2.18	NA	NA	NA
C9-C18 Aliphatics	C9-C18 ALIP	mg/kg	< 40.7	< 42.5	8.53	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	< 0.0825	< 0.0838	< 3.48	NA	NA	NA
Carbon tetrachloride	56-23-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Chlorobenzene	108-90-7	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Chloroethane	75-00-3	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.537	NA	< 0.571
Chloroform	67-66-3	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Chloromethane	74-87-3	mg/kg	< 0.412	< 0.419	< 17.4	< 0.215	NA	< 0.228
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Dibromochloromethane	124-48-1	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Dibromomethane	74-95-3	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	< 0.537	NA	< 0.571
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	< 0.215	NA	< 0.228
Dry Weight	DRYWT	mg/kg	97.2	95.7	91.9	NA	NA	NA
Ethylbenzene	100-41-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Extractable Petroleum Hydrocarbons, Total	EPH	mg/kg	760	358	458	NA	NA	NA
Hexachlorobutadiene	87-68-3	mg/kg	< 0.412	< 0.419	< 17.4	< 0.268	NA	< 0.285
Isopropylbenzene	98-82-8	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
m,p-Xylenes	MP-XYL	mg/kg	< 0.165	< 0.168	< 6.96	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.412	< 0.419	< 17.4	< 0.0537	NA	< 0.0571
Methylene chloride	75-09-2	mg/kg	< 0.825	< 0.838	< 34.8	0.123	NA	< 0.228
Naphthalene	91-20-3	mg/kg	< 0.412	< 0.419	< 17.4	< 0.215	NA	< 0.228
n-Butylbenzene	104-51-8	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
n-Hexane	110-54-3	mg/kg	< 0.412	< 0.419	< 17.4	NA	NA	NA
n-Propylbenzene	103-65-1	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
o-Xylene	95-47-6	mg/kg	< 0.0825	< 0.0838	< 3.48	NA	NA	NA
Percent Moisture	MOIST	mg/kg	NA	NA	NA	3.7	10.6	13.5
sec-Butylbenzene	135-98-8	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Styrene	100-42-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
tert-Butylbenzene	98-06-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Tetrachloroethene	127-18-4	mg/kg	0.527	0.16	204	0.0578	NA	< 0.0571
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	< 2.15	NA	< 2.28
Toluene	108-88-3	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	19,600	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	22,800	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	27.6	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0537	NA	< 0.0571
Trichloroethene	79-01-6	mg/kg	0.0561	0.0536	76.3	< 0.0537	NA	< 0.0571
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.215	NA	< 0.228
Vinyl chloride	75-01-4	mg/kg	< 0.0825	< 0.0838	< 3.48	< 0.0215	NA	< 0.0228
Volatile Petroleum Hydrocarbons, Total	VPH	mg/kg	< 4.12	< 4.19	32.5	NA	NA	NA
Xylenes, total	1330-20-7	mg/kg	< 0.247	< 0.251	< 10.4	< 0.161	NA	< 0.171

Notes:
 Surface soil data (0-2 ft bgs)
Bold indicates detected concentration
 < = analyte not detected
 mg/kg = milligram per kilogram
 NA = Not Analyzed

Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	EC Bottoms A 11/20/1997 N 6 - 6 ft	EC Bottoms C 12/2/1997 N 6 - 6 ft	EC Bottoms E 12/2/1997 N 6 - 6 ft	CC Bottom A 10/8/1997 N 6 - 6 ft	CC Bottom B 10/8/1997 N 6 - 6 ft	ALSAB-1 4/13/2000 N 0 - 3 ft	ALSAB-1-2 Resample 5/2/2000 N 0 - 3 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.20	NA
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,1-Dichloroethane	75-34-3	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.20	NA
1,1-Dichloroethene	75-35-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,1-Dichloropropene	563-58-6	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,2,3-Trichlorobenzene	87-61-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	96-18-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,2,4-Trichlorobenzene	120-82-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	95-63-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	106-93-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.10	< 0.10	< 0.10	6.2	3.8	< 0.20	NA
1,2-Dichloroethane	107-06-2	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,2-Dichloropropene	78-87-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,3,5-Trimethylbenzene	108-67-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	541-73-1	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,3-Dichloropropane	142-28-9	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.10	< 0.10	< 0.10	1.3	0.84	< 0.20	NA
1-Chlorohexane	544-10-5	mg/kg	NA	NA	NA	NA	NA	NA	NA
2,2-Dichloropropane	594-20-7	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
2-Butanone	78-93-3	mg/kg	NA	NA	NA	NA	NA	< 4.00	NA
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
2-Chlorotoluene	95-49-8	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
2-Hexanone	591-78-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
4-Isopropyltoluene	99-87-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	108-10-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Acetone	67-64-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Barium	7440-39-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Bromobenzene	108-86-1	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Bromochloromethane	74-97-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Bromodichloromethane	75-27-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Bromoform	75-25-2	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Bromomethane	74-83-9	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Cadmium	7440-43-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Chlorobenzene	108-90-7	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.20	NA
Chloroethane	75-00-3	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Chloroform	67-66-3	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Chloromethane	74-87-3	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Chromium	7440-47-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	mg/kg	0.196	< 0.10	< 0.10	< 0.10	< 0.10	< 0.20	NA
cis-1,3-Dichloropropene	10061-01-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Dibromochloromethane	124-48-1	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Dibromomethane	74-95-3	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Dichlorodifluoromethane	75-71-8	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Hexachlorobutadiene	87-68-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
Iron	7439-89-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
Lead	7439-92-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Manganese	7439-96-5	mg/kg	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Methylene chloride	75-09-2	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Naphthalene	91-20-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
n-Butylbenzene	104-51-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
n-Hexane	110-54-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
n-Propylbenzene	103-65-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
o-Xylene	95-47-6	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	NA	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Silver	7440-22-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Styrene	100-42-5	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
tert-Butylbenzene	98-06-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	127-18-4	mg/kg	0.447	0.416	< 0.10	< 0.10	0.5	< 0.20	NA
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	517	614	91.3	9,820	7,711	NA	1,240
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.20	NA
trans-1,3-Dichloropropene	10061-02-6	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Trichloroethene	79-01-6	mg/kg	0.103	< 0.10	< 0.10	< 0.10	< 0.10	< 0.20	NA
Trichlorofluoromethane	75-69-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Vinyl chloride	75-01-4	mg/kg	NA	NA	NA	NA	NA	< 0.20	NA
Xylenes, total	1330-20-7	mg/kg	NA	NA	NA	NA	NA	NA	NA

Notes:

- Subsurface soil data (Greater than 2 to 10 ft bgs)
- SBS-9 is a blind field duplicate of SBS-8
- Bold** indicates detected concentration
- < = analyte not detected
- mg/kg = milligram per kilogram
- NA = Not Analyzed

Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	ALSAB-2 4/13/2000 N 0 - 3 ft	ALSAB-2-2 Resample 5/2/2000 N 0 - 3 ft	ALSAB-3 4/13/2000 N 0 - 3 ft	ALSAB-4 4/13/2000 N 0 - 3 ft	CC-2 Resamples 5/9/2000 N 6 - 6 ft	SC-2 Resamples 5/9/2000 N 6 - 6 ft	SAB-1 4/6/2000 N 2 - 3 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,1-Dichloroethane	75-34-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,1-Dichloroethene	75-35-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,1-Dichloropropene	563-58-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,2,3-Trichlorobenzene	87-61-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,2,4-Trichlorobenzene	120-82-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	95-63-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	106-93-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,2-Dichloroethane	107-06-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,2-Dichloropropane	78-87-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,3,5-Trimethylbenzene	108-67-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,3-Dichloropropane	142-28-9	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
1-Chlorohexane	544-10-5	mg/kg	NA	NA	NA	NA	NA	NA	NA
2,2-Dichloropropane	594-20-7	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
2-Butanone	78-93-3	mg/kg	< 4.00	NA	< 4.00	< 4.00	NA	NA	< 4.00
2-Chloroethyl vinyl ether	110-75-8	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
2-Chlorotoluene	95-49-8	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
2-Hexanone	591-78-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
4-Isopropyltoluene	99-87-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone	108-10-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Acetone	67-64-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Barium	7440-39-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Bromobenzene	108-86-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Bromochloromethane	74-97-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Bromodichloromethane	75-27-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Bromoform	75-25-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Bromomethane	74-83-9	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Cadmium	7440-43-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Chlorobenzene	108-90-7	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Chloroethane	75-00-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Chloroform	67-66-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Chloromethane	74-87-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Chromium	7440-47-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Dibromochloromethane	124-48-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Dibromomethane	74-95-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Hexachlorobutadiene	87-68-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
Iron	7439-89-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
Lead	7439-92-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Manganese	7439-96-5	mg/kg	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Methylene chloride	75-09-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Naphthalene	91-20-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
n-Butylbenzene	104-51-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
n-Hexane	110-54-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
n-Propylbenzene	103-65-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
o-Xylene	95-47-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	NA	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Silver	7440-22-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Styrene	100-42-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
tert-Butylbenzene	98-06-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	127-18-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	1,770	330	50	68	1,170	1,970
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Trichloroethene	79-01-6	mg/kg	0.27	NA	< 0.20	< 0.20	NA	NA	< 0.20
Trichlorofluoromethane	75-69-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Vinyl chloride	75-01-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	< 0.20
Xylenes, total	1330-20-7	mg/kg	NA	NA	NA	NA	NA	NA	NA

Notes:

Subsurface soil data (Greater than 2 to 10 ft bgs)

SBS-9 is a blind field duplicate of SBS-8

Bold indicates detected concentration

< = analyte not detected

mg/kg = milligram per kilogram

NA = Not Analyzed

**Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SAB-2	SAB-2-2	SAB-3	SAB-4	SAB-4-2	SBS-1A	SBS-1B
			4/6/2000 N 2 - 3 ft	Resampled 5/2/2000 N 2 - 3 ft	4/6/2000 N 2 - 3 ft	4/6/2000 N 2 - 3 ft	Resampled 5/2/2000 N 2 - 3 ft	9/14/2007 11:46:00 AM N 7 - 7 ft	9/14/2007 11:37:00 AM N 7 - 7 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,1-Dichloroethane	75-34-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,1-Dichloroethene	75-35-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,1-Dichloropropene	563-58-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,2,3-Trichlorobenzene	87-61-6	mg/kg	NA	NA	NA	NA	NA	< 0.347	< 0.352
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,2,4-Trichlorobenzene	120-82-1	mg/kg	NA	NA	NA	NA	NA	< 0.347	< 0.352
1,2,4-Trimethylbenzene	95-63-6	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	NA	NA	NA	NA	NA	< 0.347	< 0.352
1,2-Dibromoethane	106-93-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,2-Dichloroethane	107-06-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,2-Dichloropropane	78-87-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,3,5-Trimethylbenzene	108-67-8	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,3-Dichloropropane	142-28-9	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
1-Chlorohexane	544-10-5	mg/kg	NA	NA	NA	NA	NA	< 0.694	< 0.704
2,2-Dichloropropane	594-20-7	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
2-Butanone	78-93-3	mg/kg	< 4.00	NA	< 4.00	< 4.00	NA	< 0.694	< 0.704
2-Chloroethyl vinyl ether	110-75-8	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
2-Hexanone	591-78-6	mg/kg	NA	NA	NA	NA	NA	< 0.694	< 0.704
4-Chlorotoluene	106-43-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
4-Isopropyltoluene	99-87-6	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
4-Methyl-2-pentanone	108-10-1	mg/kg	NA	NA	NA	NA	NA	< 0.694	< 0.704
Acetone	67-64-1	mg/kg	NA	NA	NA	NA	NA	< 0.694	< 0.704
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Barium	7440-39-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Bromobenzene	108-86-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Bromochloromethane	74-97-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Bromodichloromethane	75-27-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Bromoform	75-25-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Bromomethane	74-83-9	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Cadmium	7440-43-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
Carbon tetrachloride	56-23-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Chlorobenzene	108-90-7	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Chloroethane	75-00-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Chloroform	67-66-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Chloromethane	74-87-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.347	< 0.352
Chromium	7440-47-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Dibromochloromethane	124-48-1	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Dibromomethane	74-95-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	NA	NA	NA	NA	NA	96.4	95.6
Ethylbenzene	100-41-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Hexachlorobutadiene	87-68-3	mg/kg	NA	NA	NA	NA	NA	< 0.347	< 0.352
Iron	7439-89-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
Lead	7439-92-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.139	< 0.141
Manganese	7439-96-5	mg/kg	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.347	< 0.352
Methylene chloride	75-09-2	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.694	< 0.704
Naphthalene	91-20-3	mg/kg	NA	NA	NA	NA	NA	< 0.347	< 0.352
n-Butylbenzene	104-51-8	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
n-Hexane	110-54-3	mg/kg	NA	NA	NA	NA	NA	< 0.347	< 0.352
n-Propylbenzene	103-65-1	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
o-Xylene	95-47-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	NA	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
Selenium	7782-49-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Silver	7440-22-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Styrene	100-42-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
tert-Butylbenzene	98-06-6	mg/kg	NA	NA	NA	NA	NA	< 0.0694	< 0.0704
Tetrachloroethene	127-18-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	2,300	1,760	NA	224	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Trichloroethene	79-01-6	mg/kg	0.21	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Trichlorofluoromethane	75-69-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Vinyl chloride	75-01-4	mg/kg	< 0.20	NA	< 0.20	< 0.20	NA	< 0.0694	< 0.0704
Xylenes, total	1330-20-7	mg/kg	NA	NA	NA	NA	NA	< 0.208	< 0.211

Notes:

- Subsurface soil data (Greater than 2 to 10 ft bgs)
- SBS-9 is a blind field duplicate of SBS-8
- Bold** indicates detected concentration
- < = analyte not detected
- mg/kg = milligram per kilogram
- NA = Not Analyzed

Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	SBS-1C	SBS-1D	SBS-1E	SBS-2A	SBS-2B	SBS-2C	SBS-2D
			9/14/2007 11:41:00 AM N 7 - 7 ft	9/14/2007 11:34:00 AM N 6 - 6 ft	9/14/2007 11:30:00 AM N 8.5 - 8.5 ft	9/14/2007 9:31:00 AM N 7 - 7 ft	9/14/2007 9:41:00 AM N 6.5 - 6.5 ft	9/14/2007 9:25:00 AM N 4 - 6 ft	9/14/2007 9:34:00 AM N 7.5 - 7.5 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,2-Dichloropropene	78-87-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
1-Chlorohexane	544-10-5	mg/kg	< 0.666	< 0.765	< 0.696	< 0.681	< 0.699	< 0.722	< 0.640
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
2-Butanone	78-93-3	mg/kg	< 0.666	< 0.765	< 0.696	< 0.681	< 0.699	< 0.722	< 0.640
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
2-Hexanone	591-78-6	mg/kg	< 0.666	< 0.765	< 0.696	< 0.681	< 0.699	< 0.722	< 0.640
4-Chlorotoluene	106-43-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.666	< 0.765	< 0.696	< 0.681	< 0.699	< 0.722	< 0.640
Acetone	67-64-1	mg/kg	< 0.666	< 0.765	< 0.696	< 0.681	< 0.699	< 0.722	< 0.640
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	NA	NA	NA	1.88	2.26	2.59	1.67
Barium	7440-39-3	mg/kg	NA	NA	NA	121	159	151	121
Benzene	71-43-2	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Bromobenzene	108-86-1	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Bromochloromethane	74-97-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Bromodichloromethane	75-27-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Bromoform	75-25-2	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Bromomethane	74-83-9	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Cadmium	7440-43-9	mg/kg	NA	NA	NA	0.283	0.264	0.182	0.2
Carbon disulfide	75-15-0	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Carbon tetrachloride	56-23-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Chlorobenzene	108-90-7	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Chloroethane	75-00-3	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Chloroform	67-66-3	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Chloromethane	74-87-3	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
Chromium	7440-47-3	mg/kg	NA	NA	NA	16.2	19.2	14.4	13.8
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Dibromochloromethane	124-48-1	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Dibromomethane	74-95-3	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	96.3	95.4	96.7	97.3	96.4	96.9	95.9
Ethylbenzene	100-41-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Hexachlorobutadiene	87-68-3	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
Iron	7439-89-6	mg/kg	NA	NA	NA	16,000	15,700	14,300	22,400
Isopropylbenzene	98-82-8	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Lead	7439-92-1	mg/kg	NA	NA	NA	4.74	5.74	5.48	4.31
m,p-Xylenes	MP-XYL	mg/kg	< 0.133	< 0.153	< 0.139	< 0.136	< 0.140	< 0.144	< 0.128
Manganese	7439-96-5	mg/kg	NA	NA	NA	329	268	318	305
Mercury	7439-97-6	mg/kg	NA	NA	NA	< 0.110	< 0.0985	0.0153	< 0.112
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
Methylene chloride	75-09-2	mg/kg	< 0.666	< 0.765	< 0.696	< 0.681	< 0.699	< 0.722	< 0.640
Naphthalene	91-20-3	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
n-Butylbenzene	104-51-8	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
n-Hexane	110-54-3	mg/kg	< 0.333	< 0.382	< 0.348	< 0.340	< 0.349	< 0.361	< 0.320
n-Propylbenzene	103-65-1	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
o-Xylene	95-47-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	NA	NA	NA	9.02	9.03	8.98	8.95
sec-Butylbenzene	135-98-8	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Selenium	7782-49-2	mg/kg	NA	NA	NA	0.339	0.411	0.3	0.346
Silver	7440-22-4	mg/kg	NA	NA	NA	0.0668	0.0783	0.059	0.0601
Styrene	100-42-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
tert-Butylbenzene	98-06-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Tetrachloroethene	127-18-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCcpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Trichloroethene	79-01-6	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Vinyl chloride	75-01-4	mg/kg	< 0.0666	< 0.0765	< 0.0696	< 0.0681	< 0.0699	< 0.0722	< 0.0640
Xylenes, total	1330-20-7	mg/kg	< 0.200	< 0.229	< 0.209	< 0.204	< 0.210	< 0.216	< 0.192

Notes:
 Subsurface soil data (Greater than 2 to 10 ft bgs)
 SBS-9 is a blind field duplicate of SBS-8
Bold indicates detected concentration
 < = analyte not detected
 mg/kg = milligram per kilogram
 NA = Not Analyzed

**Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SBS-2E	SBS-3A	SBS-3B	SBS-3C	SBS-3D	SBS-3E	SBS-4A
			9/14/2007 9:11:00 AM N 9 - 9 ft	9/14/2007 8:10:00 AM N 7 - 7 ft	9/14/2007 8:30:00 AM N 6.5 - 6.5 ft	9/14/2007 8:15:00 AM N 5.5 - 5.5 ft	9/14/2007 8:25:00 AM N 6.5 - 6.5 ft	9/14/2007 9:45:00 AM N 8.5 - 8.5 ft	9/14/2007 10:13:00 AM N 6.5 - 6.5 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,2-Dichloropropene	78-87-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
1-Chlorohexane	544-10-5	mg/kg	< 0.967	< 0.674	< 0.678	< 0.680	< 0.633	< 0.740	< 0.737
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
2-Butanone	78-93-3	mg/kg	< 0.967	< 0.674	< 0.678	< 0.680	< 0.633	< 0.740	< 0.737
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
2-Hexanone	591-78-6	mg/kg	< 0.967	< 0.674	< 0.678	< 0.680	< 0.633	< 0.740	< 0.737
4-Chlorotoluene	106-43-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.967	< 0.674	< 0.678	< 0.680	< 0.633	< 0.740	< 0.737
Acetone	67-64-1	mg/kg	< 0.967	< 0.674	< 0.678	< 0.680	< 0.633	< 0.740	< 0.737
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	2.93	2.86	2.33	2.2	2.34	2.12	2.15
Barium	7440-39-3	mg/kg	161	132	107	111	152	119	146
Benzene	71-43-2	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Bromobenzene	108-86-1	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Bromochloromethane	74-97-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Bromodichloromethane	75-27-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Bromoform	75-25-2	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Bromomethane	74-83-9	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Cadmium	7440-43-9	mg/kg	0.276	0.216	0.188	0.283	0.206	0.217	0.232
Carbon disulfide	75-15-0	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Carbon tetrachloride	56-23-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Chlorobenzene	108-90-7	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Chloroethane	75-00-3	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Chloroform	67-66-3	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Chloromethane	74-87-3	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
Chromium	7440-47-3	mg/kg	19.6	15	14.1	16.4	17.5	18.8	16
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Dibromochloromethane	124-48-1	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Dibromomethane	74-95-3	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	76.6	97	96.4	95.2	96.3	96.1	97
Ethylbenzene	100-41-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Hexachlorobutadiene	87-68-3	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
Iron	7439-89-6	mg/kg	20,500	15,400	16,300	17,700	16,400	17,800	15,400
Isopropylbenzene	98-82-8	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Lead	7439-92-1	mg/kg	6.03	6.18	8.34	6.22	5.7	5.58	5.48
m,p-Xylenes	MP-XYL	mg/kg	< 0.193	< 0.135	< 0.136	< 0.136	< 0.127	< 0.148	< 0.147
Manganese	7439-96-5	mg/kg	380	277	256	304	317	282	236
Mercury	7439-97-6	mg/kg	< 0.138	< 0.107	< 0.108	0.0114	< 0.110	< 0.103	0.0124
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
Methylene chloride	75-09-2	mg/kg	< 0.967	< 0.674	< 0.678	< 0.680	< 0.633	< 0.740	< 0.737
Naphthalene	91-20-3	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
n-Butylbenzene	104-51-8	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
n-Hexane	110-54-3	mg/kg	< 0.483	< 0.337	< 0.339	< 0.340	< 0.317	< 0.370	< 0.368
n-Propylbenzene	103-65-1	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
o-Xylene	95-47-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	8.75	8.88	8.9	8.79	8.83	8.82	8.51
sec-Butylbenzene	135-98-8	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Selenium	7782-49-2	mg/kg	0.484	0.316	0.325	0.396	0.365	0.358	0.36
Silver	7440-22-4	mg/kg	< 0.673	< 0.526	< 0.552	0.0618	0.0617	0.0757	0.071
Styrene	100-42-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
tert-Butylbenzene	98-06-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Tetrachloroethene	127-18-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0967	< 0.0674	0.0176	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Trichloroethene	79-01-6	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Vinyl chloride	75-01-4	mg/kg	< 0.0967	< 0.0674	< 0.0678	< 0.0680	< 0.0633	< 0.0740	< 0.0737
Xylenes, total	1330-20-7	mg/kg	< 0.290	< 0.202	< 0.203	< 0.204	< 0.190	< 0.222	< 0.221

Notes:
 Subsurface soil data (Greater than 2 to 10 ft bgs)
 SBS-9 is a blind field duplicate of SBS-8
Bold indicates detected concentration
 < = analyte not detected
 mg/kg = milligram per kilogram
 NA = Not Analyzed

**Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SBS-4B	SBS-4C	SBS-4D	SBS-4E	SBS-5A	SBS-5B	SBS-5C
			9/14/2007 10:45:00 AM N 6.5 - 6.5 ft	9/14/2007 10:55:00 AM N 6.5 - 6.5 ft	9/14/2007 10:33:00 AM N 6.5 - 6.5 ft	9/14/2007 10:13:00 AM N 8.5 - 8.5 ft	9/13/2007 6:12:00 PM N 5 - 6 ft	9/13/2007 6:21:00 PM N 6 - 6 ft	9/13/2007 6:27:00 PM N 5 - 5 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
1-Chlorohexane	544-10-5	mg/kg	< 0.766	< 0.649	< 0.697	< 0.758	< 0.659	< 0.659	< 0.640
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
2-Butanone	78-93-3	mg/kg	< 0.766	< 0.649	< 0.697	< 0.758	< 0.659	< 0.659	< 0.640
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
2-Hexanone	591-78-6	mg/kg	< 0.766	< 0.649	< 0.697	< 0.758	< 0.659	< 0.659	< 0.640
4-Chlorotoluene	106-43-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.766	< 0.649	< 0.697	< 0.758	< 0.659	< 0.659	< 0.640
Acetone	67-64-1	mg/kg	< 0.766	< 0.649	< 0.697	< 0.758	< 0.659	< 0.659	< 0.640
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	2.32	2.35	2.36	3.33	NA	NA	NA
Barium	7440-39-3	mg/kg	157	167	159	132	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Bromobenzene	108-86-1	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Bromochloromethane	74-97-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Bromodichloromethane	75-27-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Bromoform	75-25-2	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Bromomethane	74-83-9	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Cadmium	7440-43-9	mg/kg	0.235	0.253	0.264	0.178	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Carbon tetrachloride	56-23-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Chlorobenzene	108-90-7	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Chloroethane	75-00-3	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Chloroform	67-66-3	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Chloromethane	74-87-3	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
Chromium	7440-47-3	mg/kg	18.3	19.3	19.7	19.5	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Dibromochloromethane	124-48-1	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Dibromomethane	74-95-3	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	95.9	96.6	97.6	96.6	93.7	93.6	94.1
Ethylbenzene	100-41-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Hexachlorobutadiene	87-68-3	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
Iron	7439-89-6	mg/kg	18,500	18,500	17,300	16,700	NA	NA	NA
Isopropylbenzene	98-82-8	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Lead	7439-92-1	mg/kg	6.12	5.92	5.98	5.52	NA	NA	NA
m,p-Xylenes	MP-XYL	mg/kg	< 0.153	< 0.130	< 0.139	< 0.152	< 0.132	< 0.132	< 0.128
Manganese	7439-96-5	mg/kg	300	359	276	286	NA	NA	NA
Mercury	7439-97-6	mg/kg	< 0.100	0.0281	< 0.0998	< 0.109	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
Methylene chloride	75-09-2	mg/kg	< 0.766	< 0.649	< 0.697	< 0.758	< 0.659	< 0.659	< 0.640
Naphthalene	91-20-3	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
n-Butylbenzene	104-51-8	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
n-Hexane	110-54-3	mg/kg	< 0.383	< 0.324	< 0.349	< 0.379	< 0.330	< 0.330	< 0.320
n-Propylbenzene	103-65-1	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
o-Xylene	95-47-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	8.46	8.52	8.98	8.75	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Selenium	7782-49-2	mg/kg	0.36	0.415	0.481	0.302	NA	NA	NA
Silver	7440-22-4	mg/kg	0.0678	0.0755	0.0739	< 0.539	NA	NA	NA
Styrene	100-42-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
tert-Butylbenzene	98-06-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Tetrachloroethene	127-18-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	0.0428	0.0409	0.041
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Trichloroethene	79-01-6	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Vinyl chloride	75-01-4	mg/kg	< 0.0766	< 0.0649	< 0.0697	< 0.0758	< 0.0659	< 0.0659	< 0.0640
Xylenes, total	1330-20-7	mg/kg	< 0.230	< 0.195	< 0.209	< 0.227	< 0.198	< 0.198	< 0.192

Notes:

- Subsurface soil data (Greater than 2 to 10 ft bgs)
- SBS-9 is a blind field duplicate of SBS-8
- Bold** indicates detected concentration
- < = analyte not detected
- mg/kg = milligram per kilogram
- NA = Not Analyzed

**Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SBS-5D	SBS-5E	SBS-6A	SBS-6B	SBS-6C	SBS-6D	SBS-6E
			9/13/2007 6:14:00 PM N 5 - 5 ft	9/13/2007 6:10:00 PM N 8 - 8 ft	9/14/2007 2:37:00 PM N 6.5 - 6.5 ft	9/14/2007 2:47:00 PM N 7 - 7 ft	9/14/2007 2:40:00 PM N 7 - 7 ft	9/14/2007 2:43:00 PM N 6 - 6 ft	9/14/2007 2:33:00 PM N 8 - 8 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
1-Chlorohexane	544-10-5	mg/kg	< 0.651	< 0.657	< 0.699	< 0.654	< 0.738	< 0.658	< 0.767
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
2-Butanone	78-93-3	mg/kg	< 0.651	< 0.657	< 0.699	< 0.654	< 0.738	< 0.658	< 0.767
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
2-Hexanone	591-78-6	mg/kg	< 0.651	< 0.657	< 0.699	< 0.654	< 0.738	< 0.658	< 0.767
4-Chlorotoluene	106-43-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.651	< 0.657	< 0.699	< 0.654	< 0.738	< 0.658	< 0.767
Acetone	67-64-1	mg/kg	< 0.651	< 0.657	< 0.699	< 0.654	< 0.738	< 0.658	< 0.767
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Barium	7440-39-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Bromobenzene	108-86-1	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Bromochloromethane	74-97-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Bromodichloromethane	75-27-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Bromoform	75-25-2	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Bromomethane	74-83-9	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Cadmium	7440-43-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Carbon tetrachloride	56-23-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Chlorobenzene	108-90-7	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Chloroethane	75-00-3	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Chloroform	67-66-3	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Chloromethane	74-87-3	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
Chromium	7440-47-3	mg/kg	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Dibromochloromethane	124-48-1	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Dibromomethane	74-95-3	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	93.7	91.7	96.7	96.4	96.5	97	96.6
Ethylbenzene	100-41-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Hexachlorobutadiene	87-68-3	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
Iron	7439-89-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Lead	7439-92-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	mg/kg	< 0.130	< 0.131	< 0.140	< 0.131	< 0.148	< 0.132	< 0.153
Manganese	7439-96-5	mg/kg	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	mg/kg	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
Methylene chloride	75-09-2	mg/kg	< 0.651	< 0.657	< 0.699	< 0.654	< 0.738	< 0.658	< 0.767
Naphthalene	91-20-3	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
n-Butylbenzene	104-51-8	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
n-Hexane	110-54-3	mg/kg	< 0.325	< 0.328	< 0.349	< 0.327	< 0.369	< 0.329	< 0.383
n-Propylbenzene	103-65-1	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
o-Xylene	95-47-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	NA	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Selenium	7782-49-2	mg/kg	NA	NA	NA	NA	NA	NA	NA
Silver	7440-22-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Styrene	100-42-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
tert-Butylbenzene	98-06-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Tetrachloroethene	127-18-4	mg/kg	0.0358	0.067	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrdp	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Trichloroethene	79-01-6	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Vinyl chloride	75-01-4	mg/kg	< 0.0651	< 0.0657	< 0.0699	< 0.0654	< 0.0738	< 0.0658	< 0.0767
Xylenes, total	1330-20-7	mg/kg	< 0.195	< 0.197	< 0.210	< 0.196	< 0.221	< 0.198	< 0.230

Notes:
Subsurface soil data (Greater than 2 to 10 ft bgs)
SBS-9 is a blind field duplicate of SBS-8
Bold indicates detected concentration
< = analyte not detected
mg/kg = milligram per kilogram
NA = Not Analyzed

**Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SBS-7A	SBS-7B	SBS-7C	SBS-7D	SBS-7E	SBS-8A	SBS-8B
			9/14/2007 2:10:00 PM N 6 - 6 ft	9/14/2007 2:01:00 PM N 7 - 7 ft	9/14/2007 2:15:00 PM N 7 - 7 ft	9/14/2007 2:07:00 PM N 2 - 3 ft	9/14/2007 1:55:00 PM N 9 - 9 ft	9/14/2007 3:26:00 PM N 5.5 - 5.5 ft	9/14/2007 3:21:00 PM N 6 - 6 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
1-Chlorohexane	544-10-5	mg/kg	< 0.686	< 0.650	< 0.678	< 0.855	< 0.728	< 0.654	< 0.641
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
2-Butanone	78-93-3	mg/kg	< 0.686	< 0.650	< 0.678	< 0.855	< 0.728	< 0.654	< 0.641
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
2-Hexanone	591-78-6	mg/kg	< 0.686	< 0.650	< 0.678	< 0.855	< 0.728	< 0.654	< 0.641
4-Chlorotoluene	106-43-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.686	< 0.650	< 0.678	< 0.855	< 0.728	< 0.654	< 0.641
Acetone	67-64-1	mg/kg	< 0.686	< 0.650	< 0.678	< 0.855	< 0.728	< 0.654	< 0.641
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	1.81	2.54	1.91	5.3	1.66	1.99	6.12
Barium	7440-39-3	mg/kg	233	130	107	358	112	94.8	109
Benzene	71-43-2	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Bromobenzene	108-86-1	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Bromochloromethane	74-97-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Bromodichloromethane	75-27-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Bromoform	75-25-2	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Bromomethane	74-83-9	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Cadmium	7440-43-9	mg/kg	0.202	0.202	0.164	0.499	0.218	0.208	0.194
Carbon disulfide	75-15-0	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Carbon tetrachloride	56-23-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Chlorobenzene	108-90-7	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Chloroethane	75-00-3	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Chloroform	67-66-3	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Chloromethane	74-87-3	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
Chromium	7440-47-3	mg/kg	11.7	23.5	12.9	38.3	13.6	15.9	11.3
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Dibromochloromethane	124-48-1	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Dibromomethane	74-95-3	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	96.2	93	96.8	89	96.4	96.2	100
Ethylbenzene	100-41-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Hexachlorobutadiene	87-68-3	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
Iron	7439-89-6	mg/kg	18,600	18,200	15,000	20,400	15,600	15,300	13,800
Isopropylbenzene	98-82-8	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Lead	7439-92-1	mg/kg	5.03	4.89	4.71	22.4	4.54	4.35	44.4
m,p-Xylenes	MP-XYL	mg/kg	< 0.137	< 0.130	< 0.136	< 0.171	< 0.146	< 0.131	< 0.128
Manganese	7439-96-5	mg/kg	287	311	312	399	331	241	246
Mercury	7439-97-6	mg/kg	0.0179	0.011	0.0118	0.0466	< 0.0998	< 0.105	< 0.103
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
Methylene chloride	75-09-2	mg/kg	< 0.686	< 0.650	< 0.678	< 0.855	< 0.728	< 0.654	< 0.641
Naphthalene	91-20-3	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
n-Butylbenzene	104-51-8	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
n-Hexane	110-54-3	mg/kg	< 0.343	< 0.325	< 0.339	< 0.427	< 0.364	< 0.327	< 0.321
n-Propylbenzene	103-65-1	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
o-Xylene	95-47-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	8.65	8.51	8.86	7.45	8.86	8.87	8.78
sec-Butylbenzene	135-98-8	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Selenium	7782-49-2	mg/kg	0.322	0.291	0.241	0.47	0.426	0.317	0.247
Silver	7440-22-4	mg/kg	< 0.481	< 0.560	< 0.483	0.115	0.0765	< 0.520	0.156
Styrene	100-42-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
tert-Butylbenzene	98-06-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Tetrachloroethene	127-18-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	3.01	0.0197	< 0.0654	< 0.0641
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Trichloroethene	79-01-6	mg/kg	< 0.0686	< 0.0650	< 0.0678	0.187	< 0.0728	< 0.0654	< 0.0641
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Vinyl chloride	75-01-4	mg/kg	< 0.0686	< 0.0650	< 0.0678	< 0.0855	< 0.0728	< 0.0654	< 0.0641
Xylenes, total	1330-20-7	mg/kg	< 0.206	< 0.195	< 0.203	< 0.256	< 0.218	< 0.196	< 0.192

Notes:
Subsurface soil data (Greater than 2 to 10 ft bgs)
SBS-9 is a blind field duplicate of SBS-8
Bold indicates detected concentration
< = analyte not detected
mg/kg = milligram per kilogram
NA = Not Analyzed

**Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana**

Analyte	CAS Number	Units	SBS-8C	SBS-8D	SBS-8E	SBS-9A	SBS-9B	SBS-9C
			9/14/2007 3:31:00 PM N 7 - 7 ft	9/14/2007 3:17:00 PM N 6 - 6 ft	9/14/2007 3:11:00 PM N 8 - 8 ft	9/14/2007 3:26:00 PM FD 5.5 - 5.5 ft	9/14/2007 3:21:00 PM FD 6 - 6 ft	9/14/2007 3:31:00 PM FD 7 - 7 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
1-Chlorohexane	544-10-5	mg/kg	< 0.688	< 0.689	< 0.677	< 0.687	< 0.689	< 0.666
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
2-Butanone	78-93-3	mg/kg	< 0.688	< 0.689	< 0.677	< 0.687	< 0.689	< 0.666
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
2-Hexanone	591-78-6	mg/kg	< 0.688	< 0.689	< 0.677	< 0.687	< 0.689	< 0.666
4-Chlorotoluene	106-43-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.688	< 0.689	< 0.677	< 0.687	< 0.689	< 0.666
Acetone	67-64-1	mg/kg	< 0.688	< 0.689	< 0.677	< 0.687	< 0.689	< 0.666
Allyl chloride	107-05-1	mg/kg	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/kg	2.14	2.87	2.17	2.01	2.7	1.99
Barium	7440-39-3	mg/kg	99.6	151	91.6	112	111	81.6
Benzene	71-43-2	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Bromobenzene	108-86-1	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Bromochloromethane	74-97-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Bromodichloromethane	75-27-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Bromoform	75-25-2	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Bromomethane	74-83-9	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Cadmium	7440-43-9	mg/kg	0.177	0.185	0.2	0.19	0.162	0.11
Carbon disulfide	75-15-0	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Carbon tetrachloride	56-23-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Chlorobenzene	108-90-7	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Chloroethane	75-00-3	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Chloroform	67-66-3	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Chloromethane	74-87-3	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
Chromium	7440-47-3	mg/kg	12.7	15.3	11.1	15.7	14.7	15.9
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Dibromochloromethane	124-48-1	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Dibromomethane	74-95-3	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	NA	NA	NA	NA
Dry Weight	DRYWT	mg/kg	96.9	97.1	96.5	96.8	96.1	97.2
Ethylbenzene	100-41-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Hexachlorobutadiene	87-68-3	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
Iron	7439-89-6	mg/kg	13,400	15,000	13,800	14,900	14,200	14,200
Isopropylbenzene	98-82-8	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Lead	7439-92-1	mg/kg	5.15	5.4	4.98	6.11	5.43	4.13
m,p-Xylenes	MP-XYL	mg/kg	< 0.138	< 0.138	< 0.135	< 0.137	< 0.138	< 0.133
Manganese	7439-96-5	mg/kg	249	253	258	247	321	202
Mercury	7439-97-6	mg/kg	< 0.101	0.0136	< 0.108	0.00955	0.0151	< 0.102
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
Methylene chloride	75-09-2	mg/kg	< 0.688	< 0.689	< 0.677	< 0.687	< 0.689	< 0.666
Naphthalene	91-20-3	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
n-Butylbenzene	104-51-8	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
n-Hexane	110-54-3	mg/kg	< 0.344	< 0.344	< 0.339	< 0.343	< 0.345	< 0.333
n-Propylbenzene	103-65-1	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
o-Xylene	95-47-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Percent Moisture	MOIST	mg/kg	NA	NA	NA	NA	NA	NA
pH	PH	mg/kg	8.84	8.9	8.82	8.64	8.81	8.88
sec-Butylbenzene	135-98-8	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Selenium	7782-49-2	mg/kg	0.33	0.409	0.404	0.443	0.263	0.264
Silver	7440-22-4	mg/kg	0.0651	0.0672	< 0.475	0.211	< 0.559	< 0.440
Styrene	100-42-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
tert-Butylbenzene	98-06-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Tetrachloroethene	127-18-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	NA	NA	NA
Total Organic Carbon, RPD	TOCrdp	mg/kg	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Trichloroethene	79-01-6	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Vinyl chloride	75-01-4	mg/kg	< 0.0688	< 0.0689	< 0.0677	< 0.0687	< 0.0689	< 0.0666
Xylenes, total	1330-20-7	mg/kg	< 0.206	< 0.207	< 0.203	< 0.206	< 0.207	< 0.200

Notes:

- Subsurface soil data (Greater than 2 to 10 ft bgs)
- SBS-9 is a blind field duplicate of SBS-8
- Bold** indicates detected concentration
- < = analyte not detected
- mg/kg = milligram per kilogram
- NA = Not Analyzed

Table A-2 Summary of Analytical Subsurface Soil Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	SBS-9D 9/14/2007 3:17:00 PM FD 6 - 6 ft	SBS-9E 9/14/2007 3:11:00 PM FD 8 - 8 ft	VMP-1D (4.0-5.0') 7/10/2013 11:30:00 AM N 4 - 5 ft	VMP-1D (4.0-5.0')(5.5-8.0') 7/10/2013 11:30:00 AM N 4 - 8 ft	VMP-1D (8.0-9.0') 7/10/2013 12:10:00 PM N 8 - 9 ft
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,1,1-Trichloroethane	71-55-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	NA	NA	< 0.0502	NA	< 0.0517
1,1,2-Trichloroethane	79-00-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,1-Dichloroethane	75-34-3	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,1-Dichloroethene	75-35-4	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,1-Dichloropropene	563-58-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,2,3-Trichlorobenzene	87-61-6	mg/kg	< 0.395	< 0.323	< 0.0502	NA	< 0.0517
1,2,3-Trichloropropane	96-18-4	mg/kg	< 0.0789	< 0.0646	< 0.201	NA	< 0.207
1,2,4-Trichlorobenzene	120-82-1	mg/kg	< 0.395	< 0.323	< 0.0502	NA	< 0.0517
1,2,4-Trimethylbenzene	95-63-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	< 0.395	< 0.323	< 0.201	NA	< 0.207
1,2-Dibromoethane	106-93-4	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,2-Dichlorobenzene	95-50-1	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,2-Dichloroethane	107-06-2	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,2-Dichloropropane	78-87-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,3,5-Trimethylbenzene	108-67-8	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,3-Dichlorobenzene	541-73-1	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,3-Dichloropropane	142-28-9	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1,4-Dichlorobenzene	106-46-7	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
1-Chlorohexane	544-10-5	mg/kg	< 0.789	< 0.646	NA	NA	NA
2,2-Dichloropropane	594-20-7	mg/kg	< 0.0789	< 0.0646	< 0.201	NA	< 0.207
2-Butanone	78-93-3	mg/kg	< 0.789	< 0.646	< 0.251	NA	< 0.259
2-Chloroethyl vinyl ether	110-75-8	mg/kg	NA	NA	NA	NA	NA
2-Chlorotoluene	95-49-8	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
2-Hexanone	591-78-6	mg/kg	< 0.789	< 0.646	NA	NA	NA
4-Chlorotoluene	106-43-4	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
4-Isopropyltoluene	99-87-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
4-Methyl-2-pentanone	108-10-1	mg/kg	< 0.789	< 0.646	< 0.251	NA	< 0.259
Acetone	67-64-1	mg/kg	< 0.789	< 0.646	< 1	NA	< 1.03
Allyl chloride	107-05-1	mg/kg	NA	NA	< 0.201	NA	< 0.207
Arsenic	7440-38-2	mg/kg	2.02	2.49	NA	NA	NA
Barium	7440-39-3	mg/kg	157	126	NA	NA	NA
Benzene	71-43-2	mg/kg	< 0.0789	< 0.0646	< 0.0201	NA	< 0.0207
Bromobenzene	108-86-1	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Bromochloromethane	74-97-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Bromodichloromethane	75-27-4	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Bromoform	75-25-2	mg/kg	< 0.0789	< 0.0646	< 0.201	NA	< 0.207
Bromomethane	74-83-9	mg/kg	< 0.0789	< 0.0646	< 0.502	NA	< 0.517
Cadmium	7440-43-9	mg/kg	0.178	0.216	NA	NA	NA
Carbon disulfide	75-15-0	mg/kg	< 0.0789	< 0.0646	NA	NA	NA
Carbon tetrachloride	56-23-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Chlorobenzene	108-90-7	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Chloroethane	75-00-3	mg/kg	< 0.0789	< 0.0646	< 0.502	NA	< 0.517
Chloroform	67-66-3	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Chloromethane	74-87-3	mg/kg	< 0.395	< 0.323	< 0.201	NA	< 0.207
Chromium	7440-47-3	mg/kg	13	13.8	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
cis-1,3-Dichloropropene	10061-01-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Dibromochloromethane	124-48-1	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Dibromomethane	74-95-3	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Dichlorodifluoromethane	75-71-8	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Dichlorofluoromethane	75-43-4	mg/kg	NA	NA	< 0.502	NA	< 0.517
Diethyl ether (Ethyl ether)	60-29-7	mg/kg	NA	NA	< 0.201	NA	< 0.207
Dry Weight	DRYWT	mg/kg	97.4	96.8	NA	NA	NA
Ethylbenzene	100-41-4	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Hexachlorobutadiene	87-68-3	mg/kg	< 0.395	< 0.323	< 0.251	NA	< 0.259
Iron	7439-89-6	mg/kg	14,700	12,700	NA	NA	NA
Isopropylbenzene	98-82-8	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Lead	7439-92-1	mg/kg	6.14	5.43	NA	NA	NA
m,p-Xylenes	MP-XYL	mg/kg	< 0.158	< 0.129	NA	NA	NA
Manganese	7439-96-5	mg/kg	273	230	NA	NA	NA
Mercury	7439-97-6	mg/kg	< 0.104	< 0.106	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	mg/kg	< 0.395	< 0.323	< 0.0502	NA	< 0.0517
Methylene chloride	75-09-2	mg/kg	< 0.789	< 0.646	< 0.201	NA	< 0.207
Naphthalene	91-20-3	mg/kg	< 0.395	< 0.323	< 0.201	NA	< 0.207
n-Butylbenzene	104-51-8	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
n-Hexane	110-54-3	mg/kg	< 0.395	< 0.323	NA	NA	NA
n-Propylbenzene	103-65-1	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
o-Xylene	95-47-6	mg/kg	< 0.0789	< 0.0646	NA	NA	NA
Percent Moisture	MOIST	mg/kg	NA	NA	3	2	1.7
pH	PH	mg/kg	8.83	8.83	NA	NA	NA
sec-Butylbenzene	135-98-8	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Selenium	7782-49-2	mg/kg	0.352	0.346	NA	NA	NA
Silver	7440-22-4	mg/kg	0.0535	< 0.568	NA	NA	NA
Styrene	100-42-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
tert-Butylbenzene	98-06-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Tetrachloroethene	127-18-4	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Tetrahydrofuran	109-99-9	mg/kg	NA	NA	< 2.01	NA	< 2.07
Toluene	108-88-3	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Total Organic Carbon	TOC	mg/kg	NA	NA	NA	569	NA
Total Organic Carbon, average	TOCavg	mg/kg	NA	NA	NA	565	NA
Total Organic Carbon, RPD	TOCrpd	mg/kg	NA	NA	NA	1.2	NA
Total Petroleum Hydrocarbons	TPH	mg/kg	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
trans-1,3-Dichloropropene	10061-02-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Trichloroethene	79-01-6	mg/kg	< 0.0789	< 0.0646	< 0.0502	NA	< 0.0517
Trichlorofluoromethane	75-69-4	mg/kg	< 0.0789	< 0.0646	< 0.201	NA	< 0.207
Vinyl chloride	75-01-4	mg/kg	< 0.0789	< 0.0646	< 0.0201	NA	< 0.0207
Xylenes, total	1330-20-7	mg/kg	< 0.237	< 0.194	< 0.151	NA	< 0.155

Notes:
Subsurface soil data (Greater than 2 to 10 ft bgs)
SBS-9 is a blind field duplicate of SBS-8
Bold indicates detected concentration
< = analyte not detected
mg/kg = milligram per kilogram
NA = Not Analyzed

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	Gravel Pit Pond 7/13/2010 5:30:00 PM N	Gravel Pit Pond 7/13/2011 5:30:00 PM N	Harris Stock Well 7/12/2011 4:10:00 PM N	Harris Stock Well 7/13/2010 6:33:00 PM N	Harris Stock Well 7/12/2012 12:00:00 PM N	HARRIS STOCK WELL 7/8/2013 11:30:00 AM N	MW-1 7/12/2011 12:24:00 PM N	MW-1 7/13/2010 11:22:00 AM N
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,1,1-Trichloroethane	71-55-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	NA	NA	<0.5	<0.5	<0.5	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,1-Dichloroethane	75-34-3	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,1-Dichloroethene	75-35-4	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,1-Dichloropropene	563-58-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<1	<0.4	<0.5	<0.5	<0.5	<0.5	<0.4	<1
1,2,3-Trichloropropane	96-18-4	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<4	<0.2	<1
1,2,4-Trichlorobenzene	120-82-1	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<1
1,2,4-Trimethylbenzene	95-63-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<2	<0.4	<0.5	<0.5	<0.5	<4	<0.4	<2
1,2-Dibromoethane	106-93-4	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,2-Dichlorobenzene	95-50-1	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<1
1,2-Dichloroethane	107-06-2	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,2-Dichloropropane	78-87-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<4	<0.1	<1
1,3,5-Trimethylbenzene	108-67-8	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,3-Dichlorobenzene	541-73-1	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<1
1,3-Dichloropropane	142-28-9	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	<0.5	<0.5	<0.5	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<1
2,2-Dichloropropane	594-20-7	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<1	<0.1	<1
2-Butanone	78-93-3	µg/L	NA	NA	<10	<10	<10	<5	NA	NA
2-Chlorotoluene	95-49-8	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
2-Hexanone	591-78-6	µg/L	NA	NA	<10	<10	<10	<5	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	<10	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<1
4-Isopropyltoluene	99-87-6	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<0.5	<0.2	<1
4-Methyl-2-pentanone	108-10-1	µg/L	NA	NA	<10	<10	<10	<5	NA	NA
Acetone	67-64-1	µg/L	NA	NA	<10	<10	<10	<20	NA	NA
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	<10	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	NA	NA	NA	NA	NA	240,000	NA
Alkalinity, carbonate	ALKC	µg/L	NA	NA	NA	NA	NA	NA	<5,000	NA
Alkalinity, hydroxide	ALKH	µg/L	NA	NA	NA	NA	NA	NA	<5,000	NA
Alkalinity, total	ALKT	µg/L	NA	NA	NA	NA	NA	NA	240,000	230,000
Allyl chloride	107-05-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	µg/L	NA	NA	NA	NA	NA	NA	2.4	2.83
Barium	7440-39-3	µg/L	NA	NA	NA	NA	NA	NA	63.8	55.6
Benzene	71-43-2	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Bromobenzene	108-86-1	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Bromochloromethane	74-97-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<1	<0.1	<1
Bromodichloromethane	75-27-4	µg/L	<1	<0.1	<1	<1	<1	<0.5	<0.1	<1
Bromoform	75-25-2	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<4	<0.1	<1
Bromomethane	74-83-9	µg/L	<5	<0.1	<1	<1	<1	<4	<0.1	<5
Cadmium	7440-43-9	µg/L	NA	NA	NA	NA	NA	NA	<0.02	<0.02
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	<1	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<1	<0.1	<1
Chloride	16887-00-6	µg/L	NA	NA	NA	NA	NA	NA	11,000	8,400
Chlorobenzene	108-90-7	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Chloroethane	75-00-3	µg/L	<5	<0.25	<1	<1	<1	<1	<0.25	<5
Chloroform	67-66-3	µg/L	0.11	0.19	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Chloromethane	74-87-3	µg/L	<5	<0.1	<0.5	<0.5	<0.5	<1	<0.1	<5
Chromium	7440-47-3	µg/L	NA	NA	NA	NA	NA	NA	0.9	0.74
cis-1,2-Dichloroethene	156-59-2	µg/L	<1	0.12	<0.5	<0.5	<0.5	<0.5	<0.1	<1
cis-1,3-Dichloropropene	10061-01-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Copper	7440-50-8	µg/L	NA	NA	NA	NA	NA	NA	1.4	0.83
Dibromochloromethane	124-48-1	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Dibromomethane	74-95-3	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Dichlorodifluoromethane	75-71-8	µg/L	<1	<0.4	<0.5	<0.5	<0.5	<1	<0.4	<1
Dichlorofluoromethane	75-43-4	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Diisopropyl ether	108-20-3	µg/L	NA	NA	<0.5	<0.5	<0.5	NA	NA	NA
Ethane	74-84-0	µg/L	NA	NA	NA	NA	NA	NA	<10	<10
Ethene	74-85-1	µg/L	NA	NA	NA	NA	NA	NA	<10	<10
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	<4	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	<0.5	<0.5	<0.5	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	87-68-3	µg/L	<1	<0.2	<0.5	<0.5	<0.5	<1	<0.2	<1
Iron	7439-89-6	µg/L	NA	NA	NA	NA	NA	NA	14.2	11.7
Isopropylbenzene	98-82-8	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Lead	7439-92-1	µg/L	NA	NA	NA	NA	NA	NA	0.03	<0.02
m,p-Xylenes	MP-XYL	µg/L	<2	<0.2	<0.5	<0.5	<0.5	<1	<0.2	<2
Manganese	7439-96-5	µg/L	NA	NA	NA	NA	NA	NA	<0.6	<0.6
Methane	74-82-8	µg/L	NA	NA	NA	NA	NA	NA	<10	<1.2
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	<5	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	NA	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	NA
Methylene chloride	75-09-2	µg/L	<1	<0.5	<0.5	<0.5	<0.5	<4	<0.5	<1
Naphthalene	91-20-3	µg/L	<1	<0.4	<1	<1	<1	<1	<0.4	<1
n-Butylbenzene	104-51-8	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Nitrate/Nitrite	NO3NO2	µg/L	NA	NA	NA	NA	NA	NA	2,300	3,200
Nitrogen	7727-37-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
n-Propylbenzene	103-65-1	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
o-Xylene	95-47-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Phosphorus	7723-14-0	µg/L	NA	NA	NA	NA	NA	NA	<50	NA
sec-Butylbenzene	135-98-8	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Selenium	7782-49-2	µg/L	NA	NA	NA	NA	NA	NA	<1	<1
Styrene	100-42-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Sulfate	14808-79-8	µg/L	NA	NA	NA	NA	NA	NA	50,000	36,000
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	<0.5	<0.5	<0.5	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	<2	<2	<2	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Tetrachloroethene	127-18-4	µg/L	<1	0.22	0.45	0.42	0.43	0.42	<0.1	<1
Tetrahydrofuran	109-99-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	108-88-3	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Total Kjeldahl Nitrogen	TKN	µg/L	NA	NA	NA	NA	NA	NA	387	191
Total Organic Carbon	TOC	µg/L	NA	NA	NA	NA	NA	NA	2,500	1,800
trans-1,2-Dichloroethene	156-60-5	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
trans-1,3-Dichloropropene	10061-02-6	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	<10	NA	NA
Trichloroethene	79-01-6	µg/L	<1	0.096	0.66	0.81	0.83	0.63	<0.1	<1
Trichlorofluoromethane	75-69-4	µg/L	<1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.1	<1
Trihalomethanes, Total	THM	µg/L	NA	NA	<0.5	<0.5	<0.5	<3.5	NA	NA
Vinyl chloride	75-01-4	µg/L	<1	<0.02	<0.5	<0.5	<0.5	<0.4	<0.02	<1
Xylenes, total	1330-20-7	µg/L	NA	NA	<0.5	<0.5	<0.5	<1.5	NA	NA

Notes:
Bold indicates detected concentration
 < = analyte not detected
 NA = not analyzed
 µg/L = microgram per liter

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
 BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	MW-1 7/9/2013 9:08:00 AM N	MW-12 7/12/2011 6:15:00 PM N	MW-12 7/13/2010 4:20:00 PM N	MW-12 7/2/2012 1:03:00 PM N	MW-12 7/8/2013 6:14:00 PM N	MW-14 7/13/2010 3:40:00 PM N	MW-14 7/13/2011 8:28:00 AM N	MW-14 7/2/2012 5:14:00 PM N
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,1,1-Trichloroethane	71-55-6	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	<1	NA	NA	NA	<1	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,1-Dichloroethane	75-34-3	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,1-Dichloroethene	75-35-4	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,1-Dichloropropene	563-58-6	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<1	<0.4	<1	<0.4	<1	<1	<0.4	<0.4
1,2,3-Trichloropropane	96-18-4	µg/L	<4	<0.2	<1	<0.2	<4	<1	<0.2	<0.2
1,2,4-Trichlorobenzene	120-82-1	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
1,2,4-Trimethylbenzene	95-63-6	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<4	<0.4	<2	<0.4	<4	<2	<0.4	<0.4
1,2-Dibromoethane	106-93-4	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,2-Dichlorobenzene	95-50-1	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
1,2-Dichloroethane	107-06-2	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,2-Dichloropropane	78-87-5	µg/L	<4	<0.1	<1	<0.1	<4	<1	<0.1	<0.1
1,3,5-Trimethylbenzene	108-67-8	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,3-Dichlorobenzene	541-73-1	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
1,3-Dichloropropane	142-28-9	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
2,2-Dichloropropane	594-20-7	µg/L	<4	<0.1	<1	<0.1	<4	<1	<0.1	<0.1
2-Butanone	78-93-3	µg/L	<5	NA	NA	NA	<5	NA	NA	NA
2-Chlorotoluene	95-49-8	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
2-Hexanone	591-78-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
4-Isopropyltoluene	99-87-6	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
4-Methyl-2-pentanone	108-10-1	µg/L	<5	NA	NA	NA	<5	NA	NA	NA
Acetone	67-64-1	µg/L	<20	NA	NA	NA	<20	NA	NA	NA
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	240,000	NA	250,000	NA	NA	NA	NA
Alkalinity, carbonate	ALKC	µg/L	NA	<5,000	NA	<5,000	NA	NA	NA	NA
Alkalinity, hydroxide	ALKH	µg/L	NA	<5,000	NA	<5,000	NA	NA	NA	NA
Alkalinity, total	ALKT	µg/L	194,000	240,000	210,000	250,000	202,000	NA	NA	NA
Allyl chloride	107-05-1	µg/L	<4	NA	NA	NA	<4	NA	NA	NA
Arsenic	7440-38-2	µg/L	NA	4.1	4.05	NA	NA	NA	NA	NA
Barium	7440-39-3	µg/L	NA	90.1	77.1	NA	NA	NA	NA	NA
Benzene	71-43-2	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Bromobenzene	108-86-1	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Bromochloromethane	74-97-5	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Bromodichloromethane	75-27-4	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Bromoform	75-25-2	µg/L	<4	<0.1	<1	<0.1	<4	<1	<0.1	<0.1
Bromomethane	74-83-9	µg/L	<4	<0.1	<5	<0.1	<4	<5	<0.1	<0.1
Cadmium	7440-43-9	µg/L	NA	<0.02	<0.02	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Chloride	16887-00-6	µg/L	6,700	15,000	9,500	13,000	8,300	NA	NA	NA
Chlorobenzene	108-90-7	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Chloroethane	75-00-3	µg/L	<1	<0.25	<5	<0.25	<1	<5	<0.25	<0.25
Chloroform	67-66-3	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Chloromethane	74-87-3	µg/L	<4	<0.1	<5	<0.1	<4	<5	<0.1	<0.1
Chromium	7440-47-3	µg/L	NA	0.7	0.75	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	µg/L	<1	0.35	0.17	<0.1	<1	0.66	1.7	0.6
cis-1,3-Dichloropropene	10061-01-5	µg/L	<4	<0.1	<1	<0.1	<4	<1	<0.1	<0.1
Copper	7440-50-8	µg/L	NA	1.4	0.7	NA	NA	NA	NA	NA
Dibromochloromethane	124-48-1	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Dibromomethane	74-95-3	µg/L	<4	<0.1	<1	<0.1	<4	<1	<0.1	<0.1
Dichlorodifluoromethane	75-71-8	µg/L	<1	<0.4	<1	<0.4	<1	<1	<0.4	<0.4
Dichlorofluoromethane	75-43-4	µg/L	<1	NA	NA	NA	<1	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	µg/L	<4	NA	NA	NA	<4	NA	NA	NA
Diisopropyl ether	108-20-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	74-84-0	µg/L	NA	<10	<10	NA	NA	NA	NA	NA
Ethene	74-85-1	µg/L	NA	<10	<10	NA	NA	NA	NA	NA
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	<216	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	87-68-3	µg/L	<1	<0.2	<1	<0.2	<1	<1	<0.2	<0.2
Iron	7439-89-6	µg/L	NA	46.3	<10	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Lead	7439-92-1	µg/L	NA	0.04	<0.02	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	µg/L	NA	<0.2	<2	<0.2	NA	<2	<0.2	<0.2
Manganese	7439-96-5	µg/L	NA	1.4	<0.6	NA	NA	NA	NA	NA
Methane	74-82-8	µg/L	NA	<10	<1.2	NA	NA	NA	NA	NA
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	<1	<0.1	NA	<0.1	<1	NA	<0.1	<0.1
Methylene chloride	75-09-2	µg/L	<4	<0.5	<1	<0.5	<4	<1	<0.5	<0.5
Naphthalene	91-20-3	µg/L	<4	<0.4	<1	<0.4	<4	<1	<0.4	<0.4
n-Butylbenzene	104-51-8	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Nitrate/Nitrite	NO3NO2	µg/L	1,800	1,600	1,700	1,300	1,100	NA	NA	NA
Nitrogen	7727-37-9	µg/L	<200	NA	NA	NA	<200	NA	NA	NA
n-Propylbenzene	103-65-1	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
o-Xylene	95-47-6	µg/L	NA	<0.1	<1	<0.1	NA	<1	<0.1	<0.1
Phosphorus	7723-14-0	µg/L	51	<50	NA	274	36	NA	NA	NA
sec-Butylbenzene	135-98-8	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Selenium	7782-49-2	µg/L	NA	<1	<1	NA	NA	NA	NA	NA
Styrene	100-42-5	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Sulfate	14808-79-8	µg/L	29,000	41,000	34,000	38,000	32,900	NA	NA	NA
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Tetrachloroethene	127-18-4	µg/L	<1	0.7	<1	<0.1	0.51	1.1	2.7	1.5
Tetrahydrofuran	109-99-9	µg/L	<10	NA	NA	NA	<10	NA	NA	NA
Toluene	108-88-3	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Total Kjeldahl Nitrogen	TKN	µg/L	NA	<100	<100	<452	NA	NA	NA	NA
Total Organic Carbon	TOC	µg/L	1,400	2,200	1,200	2,300	1,100	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	µg/L	<1	<0.1	<1	<0.1	<1	<1	0.031	<0.1
trans-1,3-Dichloropropene	10061-02-6	µg/L	<4	<0.1	<1	<0.1	<4	<1	<0.1	<0.1
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	µg/L	<0.4	0.85	1	<0.1	1.1	0.47	1.1	0.48
Trichlorofluoromethane	75-69-4	µg/L	<1	<0.1	<1	<0.1	<1	<1	<0.1	<0.1
Trihalomethanes, Total	THM	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	75-01-4	µg/L	<0.4	<0.02	<1	<0.02	<0.4	<1	<0.02	<0.02
Xylenes, total	1330-20-7	µg/L	<3	NA	NA	NA	<3	NA	NA	NA

Notes:
 Bold indicates detected concentration
 < = analyte not detected
 NA = not analyzed
 µg/L = microgram per liter

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	MW-14	MW-18	MW-18	MW-18	MW-18	MW-19	MW-19	MW-19
			7/8/2013 5:27:00 PM N	7/12/2011 5:16:00 PM N	7/14/2010 6:20:00 PM N	7/2/2012 4:17:00 PM N	7/8/2013 4:37:00 PM N	7/12/2011 3:35:00 PM N	7/14/2010 4:10:00 PM N	7/2/2012 11:41:00 AM N
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1,1-Trichloroethane	71-55-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	<1	NA	NA	NA	<1	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloroethane	75-34-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloroethene	75-35-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloropropene	563-58-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<1	<0.4	<1	<0.4	<1	<0.4	<1	<0.4
1,2,3-Trichloropropane	96-18-4	µg/L	<4	<0.2	<1	<0.2	<4	<0.2	<1	<0.2
1,2,4-Trichlorobenzene	120-82-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
1,2,4-Trimethylbenzene	95-63-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<4	<0.4	<2	<0.4	<4	<0.4	<2	<0.4
1,2-Dibromoethane	106-93-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2-Dichlorobenzene	95-50-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
1,2-Dichloroethane	107-06-2	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2-Dichloropropane	78-87-5	µg/L	<4	<0.1	<1	<0.1	<4	<0.1	<1	<0.1
1,3,5-Trimethylbenzene	108-67-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,3-Dichlorobenzene	541-73-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
1,3-Dichloropropane	142-28-9	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
2,2-Dichloropropane	594-20-7	µg/L	<4	<0.1	<1	<0.1	<4	<0.1	<1	<0.1
2-Butanone	78-93-3	µg/L	<5	NA	NA	NA	<5	NA	NA	NA
2-Chlorotoluene	95-49-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
2-Hexanone	591-78-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
4-Isopropyltoluene	99-87-6	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
4-Methyl-2-pentanone	108-10-1	µg/L	<5	NA	NA	NA	<5	NA	NA	NA
Acetone	67-64-1	µg/L	<20	NA	NA	NA	<20	NA	NA	NA
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, carbonate	ALKC	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, hydroxide	ALKH	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, total	ALKT	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Allyl chloride	107-05-1	µg/L	<4	NA	NA	NA	<4	NA	NA	NA
Arsenic	7440-38-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7440-39-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromobenzene	108-86-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromochloromethane	74-97-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromodichloromethane	75-27-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromoform	75-25-2	µg/L	<4	<0.1	<1	<0.1	<4	<0.1	<1	<0.1
Bromomethane	74-83-9	µg/L	<4	<0.1	<5	<0.1	<4	<0.1	<5	<0.1
Cadmium	7440-43-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Chloride	16887-00-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	108-90-7	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Chloroethane	75-00-3	µg/L	<1	<0.25	<5	<0.25	<1	<0.25	<5	<0.25
Chloroform	67-66-3	µg/L	<1	0.2	0.31	0.24	<1	0.12	<1	0.12
Chloromethane	74-87-3	µg/L	<4	<0.1	<5	<0.1	<4	<0.1	<5	<0.1
Chromium	7440-47-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	µg/L	0.28	0.035	<1	<0.1	<1	<0.1	<1	<0.1
cis-1,3-Dichloropropene	10061-01-5	µg/L	<4	<0.1	<1	<0.1	<4	<0.1	<1	<0.1
Copper	7440-50-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	124-48-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Dibromomethane	74-95-3	µg/L	<4	<0.1	<1	<0.1	<4	<0.1	<1	<0.1
Dichlorodifluoromethane	75-71-8	µg/L	<1	<0.4	<1	<0.4	<1	<0.4	<1	<0.4
Dichlorofluoromethane	75-43-4	µg/L	<1	NA	NA	NA	<1	NA	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	µg/L	<4	NA	NA	NA	<4	NA	NA	NA
Diisopropyl ether	108-20-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	74-84-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethene	74-85-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	87-68-3	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
Iron	7439-89-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Lead	7439-92-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	µg/L	NA	<0.2	<2	<0.2	NA	<0.2	<2	<0.2
Manganese	7439-96-5	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methane	74-82-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	<1	<0.1	NA	<0.1	<1	<0.1	NA	<0.1
Methylene chloride	75-09-2	µg/L	<4	<0.5	<1	<0.5	<4	<0.5	<1	<0.5
Naphthalene	91-20-3	µg/L	<4	<0.4	<1	<0.4	<4	<0.4	<1	<0.4
n-Butylbenzene	104-51-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Nitrate/Nitrite	NO3NO2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nitrogen	7727-37-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
n-Propylbenzene	103-65-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
o-Xylene	95-47-6	µg/L	NA	<0.1	<1	<0.1	NA	<0.1	<1	<0.1
Phosphorus	7723-14-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Selenium	7782-49-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	100-42-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Sulfate	14808-79-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Tetrachloroethene	127-18-4	µg/L	0.67	0.39	<1	<0.39	0.37	0.23	<1	<0.2
Tetrahydrofuran	109-99-9	µg/L	<10	NA	NA	NA	<10	NA	NA	NA
Toluene	108-88-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Total Kjeldahl Nitrogen	TKN	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon	TOC	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
trans-1,3-Dichloropropene	10061-02-6	µg/L	<4	<0.1	<1	<0.1	<4	<0.1	<1	<0.1
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	µg/L	0.26	0.45	0.5	0.52	0.29	0.39	0.081	0.59
Trichlorofluoromethane	75-69-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Trihalomethanes, Total	THM	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	75-01-4	µg/L	<0.4	0.016	<1	<0.02	<0.4	<0.02	<1	<0.02
Xylenes, total	1330-20-7	µg/L	<3	NA	NA	NA	<3	NA	NA	NA

Notes:
Bold indicates detected concentration
< = analyte not detected
NA = not analyzed
µg/L = microgram per liter

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	MW-19 7/8/2013 11:42:00 AM N	MW-1A 7/3/2012 9:13:00 AM N	MW-21 7/13/2011 3:20:00 PM N	MW-21 7/14/2010 2:40:00 PM N	MW-21 7/3/2012 3:03:00 PM N	MW-21 7/9/2013 5:25:00 PM N	MW-22 7/13/2011 3:53:00 PM N	MW-22 7/14/2010 3:10:00 PM N
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,1,1-Trichloroethane	71-55-6	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	0.12	<1
1,1,2-Tetrachloroethane	79-34-5	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	<1	NA	NA	NA	NA	<1	NA	NA
1,1,2-Trichloroethane	79-00-5	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,1-Dichloroethane	75-34-3	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,1-Dichloroethene	75-35-4	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,1-Dichloropropene	563-58-6	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<1	<0.4	<0.4	<1	<0.4	<1	<0.4	<1
1,2,3-Trichloropropane	96-18-4	µg/L	<4	<0.2	<0.2	<1	<0.2	<4	<0.2	<1
1,2,4-Trichlorobenzene	120-82-1	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
1,2,4-Trimethylbenzene	95-63-6	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<4	<0.4	<0.4	<2	<0.4	<4	<0.4	<2
1,2-Dibromoethane	106-93-4	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,2-Dichlorobenzene	95-50-1	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
1,2-Dichloroethane	107-06-2	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,2-Dichloropropane	78-87-5	µg/L	<4	<0.1	<0.1	<1	<0.1	<4	<0.1	<1
1,3,5-Trimethylbenzene	108-67-8	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,3-Dichlorobenzene	541-73-1	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
1,3-Dichloropropane	142-28-9	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
2,2-Dichloropropane	594-20-7	µg/L	<4	<0.1	<0.1	<1	<0.1	<4	<0.1	<1
2-Butanone	78-93-3	µg/L	<5	NA	NA	NA	NA	<5	NA	NA
2-Chlorotoluene	95-49-8	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
2-Hexanone	591-78-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
4-Isopropyltoluene	99-87-6	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
4-Methyl-2-pentanone	108-10-1	µg/L	<5	NA	NA	NA	NA	<5	NA	NA
Acetone	67-64-1	µg/L	<20	NA	NA	NA	NA	<20	NA	NA
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	240,000	NA	NA	NA	NA	NA	NA
Alkalinity, carbonate	ALKC	µg/L	NA	<5,000	NA	NA	NA	NA	NA	NA
Alkalinity, hydroxide	ALKH	µg/L	NA	<5,000	NA	NA	NA	NA	NA	NA
Alkalinity, total	ALKT	µg/L	NA	240,000	NA	NA	NA	NA	NA	NA
Allyl chloride	107-05-1	µg/L	<4	NA	NA	NA	NA	<4	NA	NA
Arsenic	7440-38-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Barium	7440-39-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	71-43-2	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Bromobenzene	108-86-1	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Bromochloromethane	74-97-5	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Bromodichloromethane	75-27-4	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Bromoform	75-25-2	µg/L	<4	<0.1	<0.1	<1	<0.1	<4	<0.1	<1
Bromomethane	74-83-9	µg/L	<4	<0.1	<0.1	<5	<0.1	<4	<0.1	<5
Cadmium	7440-43-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Chloride	16887-00-6	µg/L	NA	9,000	NA	NA	NA	NA	NA	NA
Chlorobenzene	108-90-7	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Chloroethane	75-00-3	µg/L	<1	<0.25	<0.25	<5	<0.25	<1	<0.25	<5
Chloroform	67-66-3	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Chloromethane	74-87-3	µg/L	<4	<0.1	<0.1	<5	<0.1	<4	<0.1	<5
Chromium	7440-47-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	µg/L	<1	<0.1	0.11	0.16	0.092	<1	7.2	3.9
cis-1,3-Dichloropropene	10061-01-5	µg/L	<4	<0.1	<0.1	<1	<0.1	<4	<0.1	<1
Copper	7440-50-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	124-48-1	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Dibromomethane	74-95-3	µg/L	<4	<0.1	<0.1	<1	<0.1	<4	<0.1	<1
Dichlorodifluoromethane	75-71-8	µg/L	<1	<0.4	<0.4	<1	<0.4	<1	<0.4	<1
Dichlorofluoromethane	75-43-4	µg/L	<1	NA	NA	NA	NA	<1	NA	NA
Diethyl ether (Ethyl ether)	60-29-7	µg/L	<4	NA	NA	NA	NA	<4	NA	NA
Diisopropyl ether	108-20-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	74-84-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethene	74-85-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	NA	NA	NA	NA	NA	<208	NA	NA
Hexachlorobutadiene	87-68-3	µg/L	<1	<0.2	<0.2	<1	<0.2	<1	<0.2	<1
Iron	7439-89-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	98-82-8	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Lead	7439-92-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
m,p-Xylenes	MP-XYL	µg/L	NA	<0.2	<0.2	<2	<0.2	NA	<0.2	<2
Manganese	7439-96-5	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methane	74-82-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	<1	<0.1	<0.1	NA	<0.1	<1	<0.1	NA
Methylene chloride	75-09-2	µg/L	<4	<0.5	<0.5	<1	<0.5	<4	<0.5	<1
Naphthalene	91-20-3	µg/L	<4	<0.4	<0.4	<1	<0.4	<4	<0.4	<1
n-Butylbenzene	104-51-8	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Nitrate/Nitrite	NO3NO2	µg/L	NA	1,300	NA	NA	NA	NA	NA	NA
Nitrogen	7727-37-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
n-Propylbenzene	103-65-1	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
o-Xylene	95-47-6	µg/L	NA	<0.1	<0.1	<1	<0.1	NA	<0.1	<1
Phosphorus	7723-14-0	µg/L	NA	<100	NA	NA	NA	NA	NA	NA
sec-Butylbenzene	135-98-8	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Selenium	7782-49-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	100-42-5	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Sulfate	14808-79-8	µg/L	NA	34,000	NA	NA	NA	NA	NA	NA
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Tetrachloroethene	127-18-4	µg/L	<1	<0.1	0.27	<1	<0.23	0.35	18	4.3
Tetrahydrofuran	109-99-9	µg/L	<10	NA	NA	NA	NA	<10	NA	NA
Toluene	108-88-3	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Total Kjeldahl Nitrogen	TKN	µg/L	NA	<230	NA	NA	NA	NA	NA	NA
Total Organic Carbon	TOC	µg/L	NA	2,100	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	156-60-5	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	0.13	0.52
trans-1,3-Dichloropropene	10061-02-6	µg/L	<4	<0.1	<0.1	<1	<0.1	<4	<0.1	<1
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	µg/L	0.46	<0.1	0.2	0.31	0.12	0.15	4.5	2.4
Trichlorofluoromethane	75-69-4	µg/L	<1	<0.1	<0.1	<1	<0.1	<1	<0.1	<1
Trihalomethanes, Total	THM	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	75-01-4	µg/L	<0.4	<0.02	<0.02	<1	<0.02	<0.4	<0.02	<1
Xylenes, total	1330-20-7	µg/L	<3	NA	NA	NA	NA	<3	NA	NA

Notes:
Bold indicates detected concentration
 < = analyte not detected
 NA = not analyzed
 µg/L = microgram per liter

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	MW-22	MW-22	MW-22	MW-3	MW-3	MW-3	MW-3	MW-33
			7/3/2012 3:39:00 PM N	7/30/2013 5:21:00 PM N	7/9/2013 6:12:00 PM N	7/13/2011 4:28:00 PM N	7/14/2010 5:15:00 PM N	7/3/2012 4:12:00 PM N	7/9/2013 7:01:00 PM N	7/13/2011 11:36:00 AM FD
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,1,1-Trichloroethane	71-55-6	µg/L	<0.1	<1	NA	0.45	<1	<0.1	<1	<0.1
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	NA	<1	NA	NA	NA	NA	<1	NA
1,1,2-Trichloroethane	79-00-5	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloroethane	75-34-3	µg/L	<0.1	<1	NA	0.043	<1	<0.1	<1	<0.1
1,1-Dichloroethene	75-35-4	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloropropene	563-58-6	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<0.4	<1	NA	<0.4	<1	<0.4	<1	<0.4
1,2,3-Trichloropropane	96-18-4	µg/L	<0.2	<4	NA	<0.2	<1	<0.2	<4	<0.2
1,2,4-Trichlorobenzene	120-82-1	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
1,2,4-Trimethylbenzene	95-63-6	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<0.4	<4	NA	<0.4	<2	<0.4	<4	<0.4
1,2-Dibromoethane	106-93-4	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,2-Dichlorobenzene	95-50-1	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
1,2-Dichloroethane	107-06-2	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,2-Dichloropropane	78-87-5	µg/L	<0.1	<4	NA	<0.1	<1	<0.1	<4	<0.1
1,3,5-Trimethylbenzene	108-67-8	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,3-Dichlorobenzene	541-73-1	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
1,3-Dichloropropane	142-28-9	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
2,2-Dichloropropane	594-20-7	µg/L	<0.1	<4	NA	<0.1	<1	<0.1	<4	0.091
2-Butanone	78-93-3	µg/L	NA	<5	NA	NA	NA	NA	<5	NA
2-Chlorotoluene	95-49-8	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
2-Hexanone	591-78-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
4-Isopropyltoluene	99-87-6	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
4-Methyl-2-pentanone	108-10-1	µg/L	NA	<5	NA	NA	NA	NA	<5	NA
Acetone	67-64-1	µg/L	NA	<20	NA	NA	NA	NA	<20	NA
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	NA	NA	250,000	NA	230,000	NA	240,000
Alkalinity, carbonate	ALKC	µg/L	NA	NA	NA	<5,000	NA	<5,000	NA	<5,000
Alkalinity, hydroxide	ALKH	µg/L	NA	NA	NA	<5,000	NA	<5,000	NA	<5,000
Alkalinity, total	ALKT	µg/L	NA	NA	NA	250,000	220,000	230,000	215,000	240,000
Allyl chloride	107-05-1	µg/L	NA	<4	NA	NA	NA	NA	<4	NA
Arsenic	7440-38-2	µg/L	NA	NA	NA	2.6	3.44	NA	NA	1.7
Barium	7440-39-3	µg/L	NA	NA	NA	38.9	71.1	NA	NA	69.1
Benzene	71-43-2	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Bromobenzene	108-86-1	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Bromochloromethane	74-97-5	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Bromodichloromethane	75-27-4	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Bromoform	75-25-2	µg/L	<0.1	<4	NA	<0.1	<1	<0.1	<4	<0.1
Bromomethane	74-83-9	µg/L	<0.1	<4	NA	<0.1	<5	<0.1	<4	<0.1
Cadmium	7440-43-9	µg/L	NA	NA	NA	<0.02	<0.02	NA	NA	0.04
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Chloride	16887-00-6	µg/L	NA	NA	NA	12,000	7,000	7,400	6,900	12,000
Chlorobenzene	108-90-7	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Chloroethane	75-00-3	µg/L	<0.25	<1	NA	<0.25	<5	<0.25	<1	0.15
Chloroform	67-66-3	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Chloromethane	74-87-3	µg/L	<0.1	<4	NA	<0.1	<5	<0.1	<4	<0.1
Chromium	7440-47-3	µg/L	NA	NA	NA	1.3	1.16	NA	NA	1.4
cis-1,2-Dichloroethene	156-59-2	µg/L	1	7.7	NA	19	5.7	4	7.6	0.076
cis-1,3-Dichloropropene	10061-01-5	µg/L	<0.1	<4	NA	<0.1	<1	<0.1	<4	<0.1
Copper	7440-50-8	µg/L	NA	NA	NA	2.4	1.57	NA	NA	2.9
Dibromochloromethane	124-48-1	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Dibromomethane	74-95-3	µg/L	<0.1	<4	NA	<0.1	<1	<0.1	<4	<0.1
Dichlorodifluoromethane	75-71-8	µg/L	<0.4	<1	NA	<0.4	<1	<0.4	<1	<0.4
Dichlorofluoromethane	75-43-4	µg/L	NA	<1	NA	NA	NA	NA	<1	NA
Diethyl ether (Ethyl ether)	60-29-7	µg/L	NA	<4	NA	NA	NA	NA	<4	NA
Diisopropyl ether	108-20-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	74-84-0	µg/L	NA	NA	NA	<10	<10	NA	NA	<10
Ethene	74-85-1	µg/L	NA	NA	NA	<10	<10	NA	NA	<10
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	NA	NA	<207	NA	NA	NA	<209	NA
Hexachlorobutadiene	87-68-3	µg/L	<0.2	<1	NA	<0.2	<1	<0.2	<1	<0.2
Iron	7439-89-6	µg/L	NA	NA	NA	15.6	139	NA	NA	11.3
Isopropylbenzene	98-82-8	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Lead	7439-92-1	µg/L	NA	NA	NA	<0.02	0.086	NA	NA	0.02
m,p-Xylenes	MP-XYL	µg/L	<0.2	NA	NA	<0.2	<2	<0.2	NA	<0.2
Manganese	7439-96-5	µg/L	NA	NA	NA	<0.6	3.7	NA	NA	1
Methane	74-82-8	µg/L	NA	NA	NA	<10	<1.2	NA	NA	<10
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	<0.1	<1	NA	<0.1	NA	<0.1	<1	<0.1
Methylene chloride	75-09-2	µg/L	<0.5	<4	NA	<0.5	<1	<0.5	<4	<0.5
Naphthalene	91-20-3	µg/L	<0.4	<4	NA	<0.4	<1	<0.4	<4	<0.4
n-Butylbenzene	104-51-8	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Nitrate/Nitrite	NO3NO2	µg/L	NA	NA	NA	2,100	2,600	830	1,600	1,800
Nitrogen	7727-37-9	µg/L	NA	NA	NA	NA	NA	NA	280	NA
n-Propylbenzene	103-65-1	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
o-Xylene	95-47-6	µg/L	<0.1	NA	NA	<0.1	<1	<0.1	NA	<0.1
Phosphorus	7723-14-0	µg/L	NA	NA	NA	<50	NA	<100	55	88
sec-Butylbenzene	135-98-8	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Selenium	7782-49-2	µg/L	NA	NA	NA	<1	<1	NA	NA	<1
Styrene	100-42-5	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Sulfate	14808-79-8	µg/L	NA	NA	NA	150,000	200,000	43,000	71,000	51,000
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Tetrachloroethene	127-18-4	µg/L	1.8	6.5	NA	260	37	30	93	2.4
Tetrahydrofuran	109-99-9	µg/L	NA	<10	NA	NA	NA	NA	<10	NA
Toluene	108-88-3	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Total Kjeldahl Nitrogen	TKN	µg/L	NA	NA	NA	261	272	<330	NA	107
Total Organic Carbon	TOC	µg/L	NA	NA	NA	7,300	5,400	2,600	3,600	3,900
trans-1,2-Dichloroethene	156-60-5	µg/L	0.032	<1	NA	0.26	0.11	0.068	<1	<0.1
trans-1,3-Dichloropropene	10061-02-6	µg/L	<0.1	<4	NA	<0.1	<1	<0.1	<4	<0.1
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	µg/L	0.72	2.5	NA	27	4.7	2.9	5.3	0.64
Trichlorofluoromethane	75-69-4	µg/L	<0.1	<1	NA	<0.1	<1	<0.1	<1	<0.1
Trihalomethanes, Total	THM	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	75-01-4	µg/L	<0.02	<0.4	NA	<0.02	<1	<0.02	<0.4	<0.02
Xylenes, total	1330-20-7	µg/L	NA	<3	NA	NA	NA	NA	<3	NA

Notes:
Bold indicates detected concentration
< = analyte not detected
NA = not analyzed
µg/L = microgram per liter

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	MW-33 7/14/2010 8:20:00 AM FD	MW-33 7/3/2012 10:14:00 AM FD	MW-33 7/9/2013 12:45:00 PM FD	MW-4 7/13/2011 11:36:00 AM N	MW-4 7/14/2010 9:15:00 AM N	MW-4 7/3/2012 10:14:00 AM N	MW-4 7/9/2013 12:45:00 PM N	MW-5 7/13/2011 2:16:00 PM N
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1,1-Trichloroethane	71-55-6	µg/L	<1	<0.1	<1	<0.1	<1	0.035	<1	<0.1
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	NA	NA	<1	NA	NA	NA	<1	NA
1,1,2-Trichloroethane	79-00-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloroethane	75-34-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloroethene	75-35-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,1-Dichloropropene	563-58-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<1	<0.4	<1	<0.4	<1	<0.4	<1	<0.4
1,2,3-Trichloropropane	96-18-4	µg/L	<1	<0.2	<4	<0.2	<1	<0.2	<4	<0.2
1,2,4-Trichlorobenzene	120-82-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
1,2,4-Trimethylbenzene	95-63-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<2	<0.4	<4	<0.4	<2	<0.4	<4	<0.4
1,2-Dibromoethane	106-93-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2-Dichlorobenzene	95-50-1	µg/L	<1	0.11	<1	<0.2	0.071	0.13	<1	<0.2
1,2-Dichloroethane	107-06-2	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,2-Dichloropropane	78-87-5	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4	<0.1
1,3,5-Trimethylbenzene	108-67-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,3-Dichlorobenzene	541-73-1	µg/L	<1	0.062	<1	<0.2	<1	0.06	<1	<0.2
1,3-Dichloropropane	142-28-9	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	0.26	0.77	<1	<0.2	0.24	0.81	<1	<0.2
2,2-Dichloropropane	594-20-7	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4	<0.1
2-Butanone	78-93-3	µg/L	NA	NA	<5	NA	NA	NA	<5	NA
2-Chlorotoluene	95-49-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
2-Hexanone	591-78-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
4-Isopropyltoluene	99-87-6	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
4-Methyl-2-pentanone	108-10-1	µg/L	NA	NA	<5	NA	NA	NA	<5	NA
Acetone	67-64-1	µg/L	NA	NA	<20	NA	NA	NA	<20	NA
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	240,000	NA	230,000	NA	250,000	NA	240,000
Alkalinity, carbonate	ALKC	µg/L	NA	<5,000	NA	<5,000	NA	<5,000	NA	<5,000
Alkalinity, hydroxide	ALKH	µg/L	NA	<5,000	NA	<5,000	NA	<5,000	NA	<5,000
Alkalinity, total	ALKT	µg/L	220,000	240,000	192,000	230,000	220,000	250,000	193,000	240,000
Allyl chloride	107-05-1	µg/L	NA	NA	<4	NA	NA	NA	<4	NA
Arsenic	7440-38-2	µg/L	1.65	NA	NA	1.7	1.57	NA	NA	4.2
Barium	7440-39-3	µg/L	70.8	NA	NA	68.7	71.3	NA	NA	110
Benzene	71-43-2	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromobenzene	108-86-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromochloromethane	74-97-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromodichloromethane	75-27-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Bromoform	75-25-2	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4	<0.1
Bromomethane	74-83-9	µg/L	<5	<0.1	<4	<0.1	<5	<0.1	<4	<0.1
Cadmium	7440-43-9	µg/L	<0.02	NA	NA	0.04	<0.02	NA	NA	<0.02
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Chloride	16887-00-6	µg/L	6,700	7,100	6,800	12,000	6,700	7,100	6,700	11,000
Chlorobenzene	108-90-7	µg/L	<1	1.2	<1	<0.1	<1	1.3	<1	<0.1
Chloroethane	75-00-3	µg/L	<5	<0.25	<1	<0.25	<5	<0.25	<1	<0.25
Chloroform	67-66-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Chloromethane	74-87-3	µg/L	<5	<0.1	<4	<0.1	<5	<0.1	<4	<0.1
Chromium	7440-47-3	µg/L	1.14	NA	NA	1.5	1.16	NA	NA	1.2
cis-1,2-Dichloroethene	156-59-2	µg/L	0.31	0.8	<1	0.08	0.31	0.83	<1	0.18
cis-1,3-Dichloropropene	10061-01-5	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4	<0.1
Copper	7440-50-8	µg/L	2.44	NA	NA	2.9	2.52	NA	NA	1.7
Dibromochloromethane	124-48-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Dibromomethane	74-95-3	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4	<0.1
Dichlorodifluoromethane	75-71-8	µg/L	<1	<0.4	<1	<0.4	<1	<0.4	<1	<0.4
Dichlorofluoromethane	75-43-4	µg/L	NA	NA	<1	NA	NA	NA	<1	NA
Diethyl ether (Ethyl ether)	60-29-7	µg/L	NA	NA	<4	NA	NA	NA	<4	NA
Diisopropyl ether	108-20-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	74-84-0	µg/L	<10	NA	NA	<10	<10	NA	NA	<10
Ethene	74-85-1	µg/L	<10	NA	NA	<10	<10	NA	NA	<10
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	NA	NA	<207	NA	NA	NA	<218	NA
Hexachlorobutadiene	87-68-3	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1	<0.2
Iron	7439-89-6	µg/L	<10	NA	NA	16.6	<10	NA	NA	<10
Isopropylbenzene	98-82-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Lead	7439-92-1	µg/L	<0.02	NA	NA	<0.02	<0.02	NA	NA	<0.02
m,p-Xylenes	MP-XYL	µg/L	<2	<0.2	NA	<0.2	<2	<0.2	NA	<0.2
Manganese	7439-96-5	µg/L	<0.6	NA	NA	1.1	<0.6	NA	NA	<0.6
Methane	74-82-8	µg/L	<1.2	NA	NA	<10	<1.2	NA	NA	<10
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	NA	<0.1	<1	<0.1	NA	<0.1	<1	<0.1
Methylene chloride	75-09-2	µg/L	<1	<0.5	<4	<0.5	<1	<0.5	<4	<0.5
Naphthalene	91-20-3	µg/L	<1	<0.4	<4	<0.4	<1	<0.4	<4	<0.4
n-Butylbenzene	104-51-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Nitrate/Nitrite	NO3NO2	µg/L	1,400	420	1,400	1,700	1,300	400	1,400	1,800
Nitrogen	7727-37-9	µg/L	NA	NA	100	NA	NA	NA	220	NA
n-Propylbenzene	103-65-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
o-Xylene	95-47-6	µg/L	<1	<0.1	NA	<0.1	<1	<0.1	NA	<0.1
Phosphorus	7723-14-0	µg/L	NA	<100	120	87	NA	<100	120	73
sec-Butylbenzene	135-98-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Selenium	7782-49-2	µg/L	<1	NA	NA	<1	<1	NA	NA	<1
Styrene	100-42-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Sulfate	14808-79-8	µg/L	50,000	36,000	31,600	51,000	50,000	36,000	31,400	68,000
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Tetrachloroethene	127-18-4	µg/L	3.9	5.5	2.1	2.6	3.9	5.3	2	3
Tetrahydrofuran	109-99-9	µg/L	NA	NA	<10	NA	NA	NA	<10	NA
Toluene	108-88-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Total Kjeldahl Nitrogen	TKN	µg/L	539	<290	NA	<100	202	<927	NA	470
Total Organic Carbon	TOC	µg/L	5,300	6,000	2,300	3,800	5,400	5,400	3,200	4,000
trans-1,2-Dichloroethene	156-60-5	µg/L	<1	0.034	<1	<0.1	<1	<0.1	<1	<0.1
trans-1,3-Dichloropropene	10061-02-6	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4	<0.1
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	µg/L	1.1	1.1	0.73	0.7	1.2	1.1	0.71	1.1
Trichlorofluoromethane	75-69-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
Trihalomethanes, Total	THM	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	75-01-4	µg/L	<1	<0.02	<0.4	<0.02	<1	<0.02	<0.4	<0.02
Xylenes, total	1330-20-7	µg/L	NA	NA	<3	NA	NA	NA	<3	NA

Notes:
Bold indicates detected concentration
 < = analyte not detected
 NA = not analyzed
 µg/L = microgram per liter

Table A-3 Summary of Analytical Groundwater Data Used in the Risk Assessment Amendment
BNSF Mission Wye, Livingston, Montana

Analyte	CAS Number	Units	MW-5 7/14/2010 10:20:00 AM N	MW-5 7/3/2012 11:32:00 AM N	MW-5 7/9/2013 3:51:00 PM N	MW-9 7/13/2011 9:46:00 AM N	MW-9 7/14/2010 11:35:00 AM N	MW-9 7/3/2012 1:57:00 PM N	MW-9 7/9/2013 10:35:00 AM N
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,1,1-Trichloroethane	71-55-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	NA	NA	<1	NA	NA	NA	<1
1,1,2-Trichloroethane	79-00-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,1-Dichloroethane	75-34-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,1-Dichloroethene	75-35-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,1-Dichloropropene	563-58-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,2,3-Trichlorobenzene	87-61-6	µg/L	<1	<0.4	<1	<0.4	<1	<0.4	<1
1,2,3-Trichloropropane	96-18-4	µg/L	<1	<0.2	<4	<0.2	<1	<0.2	<4
1,2,4-Trichlorobenzene	120-82-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
1,2,4-Trimethylbenzene	95-63-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	<2	<0.4	<4	<0.4	<2	<0.4	<4
1,2-Dibromoethane	106-93-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,2-Dichlorobenzene	95-50-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
1,2-Dichloroethane	107-06-2	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,2-Dichloropropane	78-87-5	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4
1,3,5-Trimethylbenzene	108-67-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,3-Dichlorobenzene	541-73-1	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
1,3-Dichloropropane	142-28-9	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
1,3-Dichloropropene	542-75-6	µg/L	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	106-46-7	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
2,2-Dichloropropane	594-20-7	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4
2-Butanone	78-93-3	µg/L	NA	NA	<5	NA	NA	NA	<5
2-Chlorotoluene	95-49-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
2-Hexanone	591-78-6	µg/L	NA	NA	NA	NA	NA	NA	NA
2-Nitropropane	79-46-9	µg/L	NA	NA	NA	NA	NA	NA	NA
4-Chlorotoluene	106-43-4	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
4-Isopropyltoluene	99-87-6	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
4-Methyl-2-pentanone	108-10-1	µg/L	NA	NA	<5	NA	NA	NA	<5
Acetone	67-64-1	µg/L	NA	NA	<20	NA	NA	NA	<20
Acrylonitrile	107-13-1	µg/L	NA	NA	NA	NA	NA	NA	NA
Alkalinity, bicarbonate	ALKB	µg/L	NA	250,000	NA	250,000	NA	250,000	NA
Alkalinity, carbonate	ALKC	µg/L	NA	<5,000	NA	<5,000	NA	<5,000	NA
Alkalinity, hydroxide	ALKH	µg/L	NA	<5,000	NA	<5,000	NA	<5,000	NA
Alkalinity, total	ALKT	µg/L	240,000	250,000	214,000	250,000	230,000	250,000	224,000
Allyl chloride	107-05-1	µg/L	NA	NA	<4	NA	NA	NA	<4
Arsenic	7440-38-2	µg/L	4.27	NA	NA	3.9	4.01	NA	NA
Barium	7440-39-3	µg/L	102	NA	NA	116	93.9	NA	NA
Benzene	71-43-2	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Bromobenzene	108-86-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Bromochloromethane	74-97-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Bromodichloromethane	75-27-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Bromoform	75-25-2	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4
Bromomethane	74-83-9	µg/L	<5	<0.1	<4	<0.1	<5	<0.1	<4
Cadmium	7440-43-9	µg/L	<0.02	NA	NA	0.03	<0.02	NA	NA
Carbon disulfide	75-15-0	µg/L	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	56-23-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Chloride	16887-00-6	µg/L	6,500	7,400	6,700	11,000	7,000	7,900	7,300
Chlorobenzene	108-90-7	µg/L	<1	<0.1	<1	0.14	<1	<0.1	<1
Chloroethane	75-00-3	µg/L	<5	<0.25	<1	<0.25	<5	<0.25	<1
Chloroform	67-66-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Chloromethane	74-87-3	µg/L	<5	<0.1	<4	<0.1	<5	<0.1	<4
Chromium	7440-47-3	µg/L	0.93	NA	NA	1.1	0.76	NA	NA
cis-1,2-Dichloroethene	156-59-2	µg/L	0.95	0.41	<1	4.2	2.5	1.7	2.3
cis-1,3-Dichloropropene	10061-01-5	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4
Copper	7440-50-8	µg/L	1.26	NA	NA	3	1.34	NA	NA
Dibromochloromethane	124-48-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Dibromomethane	74-95-3	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4
Dichlorodifluoromethane	75-71-8	µg/L	<1	<0.4	<1	<0.4	<1	<0.4	<1
Dichlorofluoromethane	75-43-4	µg/L	NA	NA	<1	NA	NA	NA	<1
Diethyl ether (Ethyl ether)	60-29-7	µg/L	NA	NA	<4	NA	NA	NA	<4
Diisopropyl ether	108-20-3	µg/L	NA	NA	NA	NA	NA	NA	NA
Ethane	74-84-0	µg/L	<10	NA	NA	<10	<10	NA	NA
Ethene	74-85-1	µg/L	<10	NA	NA	<10	<10	NA	NA
Ethyl methacrylate	97-63-2	µg/L	NA	NA	NA	NA	NA	NA	NA
Ethyl tert-butyl ether (ETBE)	637-92-3	µg/L	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	100-41-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Extractable Petroleum Hydrocarbons, Total	EPH	µg/L	NA	NA	<199	NA	NA	NA	<213
Hexachlorobutadiene	87-68-3	µg/L	<1	<0.2	<1	<0.2	<1	<0.2	<1
Iron	7439-89-6	µg/L	<10	NA	NA	39.1	<10	NA	NA
Isopropylbenzene	98-82-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Lead	7439-92-1	µg/L	<0.02	NA	NA	0.05	<0.02	NA	NA
m,p-Xylenes	MP-XYL	µg/L	<2	<0.2	NA	<0.2	<2	<0.2	NA
Manganese	7439-96-5	µg/L	<0.6	NA	NA	4.5	0.7	NA	NA
Methane	74-82-8	µg/L	<1.2	NA	NA	<10	<1.2	NA	NA
Methyl Methacrylate	80-62-6	µg/L	NA	NA	NA	NA	NA	NA	NA
Methyl tert-butyl ether	1634-04-4	µg/L	NA	<0.1	<1	<0.1	NA	<0.1	<1
Methylene chloride	75-09-2	µg/L	<1	<0.5	<4	<0.5	<1	<0.5	<4
Naphthalene	91-20-3	µg/L	<1	<0.4	<4	<0.4	<1	<0.4	<4
n-Butylbenzene	104-51-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Nitrate/Nitrite	NO3NO2	µg/L	1,500	740	1,500	1,200	800	680	990
Nitrogen	7727-37-9	µg/L	NA	NA	180	NA	NA	NA	180
n-Propylbenzene	103-65-1	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
o-Xylene	95-47-6	µg/L	<1	<0.1	NA	<0.1	<1	<0.1	NA
Phosphorus	7723-14-0	µg/L	NA	<100	36	<50	NA	<100	34
sec-Butylbenzene	135-98-8	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Selenium	7782-49-2	µg/L	<1	NA	NA	<1	<1	NA	NA
Styrene	100-42-5	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Sulfate	14808-79-8	µg/L	57,000	40,000	37,100	62,000	35,000	41,000	35,300
Tert-amyl methyl ether (TAME)	994-05-8	µg/L	NA	NA	NA	NA	NA	NA	NA
tert-Butyl Alcohol	75-65-0	µg/L	NA	NA	NA	NA	NA	NA	NA
tert-Butylbenzene	98-06-6	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Tetrachloroethene	127-18-4	µg/L	2.4	0.83	1.4	8.6	2.4	1.9	3.6
Tetrahydrofuran	109-99-9	µg/L	NA	NA	<10	NA	NA	NA	<10
Toluene	108-88-3	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Total Kjeldahl Nitrogen	TKN	µg/L	263	<347	NA	240	144	<442	NA
Total Organic Carbon	TOC	µg/L	5,000	3,000	3,700	3,700	2,300	2,400	2,100
trans-1,2-Dichloroethene	156-60-5	µg/L	<1	<0.1	<1	0.065	0.054	0.043	<1
trans-1,3-Dichloropropene	10061-02-6	µg/L	<1	<0.1	<4	<0.1	<1	<0.1	<4
trans-1,4-Dichloro-2-butene	110-57-6	µg/L	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	79-01-6	µg/L	1.3	0.69	1.1	2.8	1.1	0.65	1.1
Trichlorofluoromethane	75-69-4	µg/L	<1	<0.1	<1	<0.1	<1	<0.1	<1
Trihalomethanes, Total	THM	µg/L	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	75-01-4	µg/L	<1	<0.02	<0.4	<0.02	<1	<0.02	<0.4
Xylenes, total	1330-20-7	µg/L	NA	NA	<3	NA	NA	NA	<3

Notes:
Bold indicates detected concentration
 < = analyte not detected
 NA = not analyzed
 µg/L = microgram per liter

Appendix B

ProUCL Outputs

**Table B-1 Summary of ProUCL Output - Surface Soil, Tetrachloroethene
BNSF Mission Wye, Livingston, Montana**

General Statistics		
Number of Valid Data	23	Number of Detected Data 11
Number of Distinct Detected Data	11	Number of Non-Detect Data 12
		Percent Non-Detects 52.17%
Raw Statistics		
		Log-transformed Statistics
Minimum Detected	0.0451	Minimum Detected -3.099
Maximum Detected	204	Maximum Detected 5.318
Mean of Detected	18.68	Mean of Detected -1.461
SD of Detected	61.46	SD of Detected 2.349
Minimum Non-Detect	0.0818	Minimum Non-Detect -2.503
Maximum Non-Detect	1.14	Maximum Non-Detect 0.131
Note: Data have multiple DLs - Use of KM Method is recommended		
		Number treated as Non-Detect 22
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected 1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage 95.65%
UCL Statistics		
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only
Shapiro Wilk Test Statistic	0.347	Shapiro Wilk Test Statistic 0.613
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value 0.85
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level
Assuming Normal Distribution		Assuming Lognormal Distribution
DL/2 Substitution Method		DL/2 Substitution Method
Mean	8.982	Mean -2.226
SD	42.51	SD 1.829
95% DL/2 (t) UCL	24.2	95% H-Stat (DL/2) UCL 2.503
Maximum Likelihood Estimate(MLE) Method N/A		
MLE method failed to converge properly		
		Log ROS Method
		Mean in Log Scale -2.473
		SD in Log Scale 1.885
		Mean in Original Scale 8.955
		SD in Original Scale 42.52
		95% t UCL 24.18
		95% Percentile Bootstrap UCL 26.69
		95% BCA Bootstrap UCL 35.58
		95% H-UCL 2.356
Gamma Distribution Test with Detected Values Only		
k star (bias corrected)	0.185	Data Distribution Test with Detected Values Only
Theta Star	100.8	Data do not follow a Discernable Distribution (0.05)
nu star	4.08	
A-D Test Statistic 2.994		
Nonparametric Statistics		
5% A-D Critical Value	0.87	Kaplan-Meier (KM) Method
K-S Test Statistic	0.87	Mean 8.969
5% K-S Critical Value	0.283	SD 41.58
Data not Gamma Distributed at 5% Significance Level		SE of Mean 9.093
Assuming Gamma Distribution		
Gamma ROS Statistics using Extrapolated Data		
Minimum	1.00E-06	95% KM (t) UCL 24.58
Maximum	204	95% KM (z) UCL 23.93
Mean	8.936	95% KM (jackknife) UCL 24.19
Median	1.00E-06	95% KM (bootstrap t) UCL 8407
SD	42.52	95% KM (BCA) UCL 26.71
k star	0.101	95% KM (Percentile Bootstrap) UCL 26.69
Theta star	88.84	95% KM (Chebyshev) UCL 48.61
Nu star	4.627	97.5% KM (Chebyshev) UCL 65.76
AppChi2	0.984	99% KM (Chebyshev) UCL 99.45
95% Gamma Approximate UCL (Use when n >= 40)	42.02	Potential UCLs to Use
95% Adjusted Gamma UCL (Use when n < 40)	47.49	99% KM (Chebyshev) UCL 99.45
Note: DL/2 is not a recommended method.		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

**Table B-2 Summary of ProUCL Output - Surface Soil, Trichloroethene
BNSF Mission Wye, Livingston, Montana**

General Statistics			
Number of Valid Data	23	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	17
		Percent Non-Detects	73.91%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0262	Minimum Detected	-3.642
Maximum Detected	76.3	Maximum Detected	4.335
Mean of Detected	12.75	Mean of Detected	-2.012
SD of Detected	31.13	SD of Detected	3.126
Minimum Non-Detect	0.0537	Minimum Non-Detect	-2.924
Maximum Non-Detect	57.1	Maximum Non-Detect	4.045
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	22
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.65%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.497	Shapiro Wilk Test Statistic	0.591
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	4.596	Mean	-2.59
SD	16.72	SD	2.044
95% DL/2 (t) UCL	10.58	95% H-Stat (DL/2) UCL	3.66
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.691
		SD in Log Scale	1.575
		Mean in Original Scale	3.368
		SD in Original Scale	15.9
		95% t UCL	9.06
		95% Percentile Bootstrap UCL	9.996
		95% BCA Bootstrap UCL	13.32
		95% H-UCL	0.726
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.194	Data do not follow a Discernable Distribution (0.05)	
Theta Star	65.66		
nu star	2.33		
A-D Test Statistic	1.51	Nonparametric Statistics	
5% A-D Critical Value	0.817	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.817	Mean	3.355
5% K-S Critical Value	0.365	SD	15.55
Data not Gamma Distributed at 5% Significance Level		SE of Mean	3.552
Assuming Gamma Distribution		95% KM (t) UCL	9.455
Gamma ROS Statistics using Extrapolated Data		95% KM (z) UCL	9.198
Minimum	1.00E-06	95% KM (jackknife) UCL	9.048
Maximum	76.3	95% KM (bootstrap t) UCL	3029
Mean	3.394	95% KM (BCA) UCL	9.991
Median	1.00E-06	95% KM (Percentile Bootstrap) UCL	9.986
SD	15.9	95% KM (Chebyshev) UCL	18.84
k star	0.0935	97.5% KM (Chebyshev) UCL	25.54
Theta star	36.3	99% KM (Chebyshev) UCL	38.7
Nu star	4.301	Potential UCLs to Use	
AppChi2	0.844	99% KM (Chebyshev) UCL	38.7
95% Gamma Approximate UCL (Use when n >= 40)	17.29		
95% Adjusted Gamma UCL (Use when n < 40)	19.67		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

**Table B-3 Summary of ProUCL Output - Sub-Surface Soil, Tetrachloroethene
BNSF Mission Wye, Livingston, Montana**

General Statistics		
Number of Valid Data	44	Number of Detected Data 16
Number of Distinct Detected Data	16	Number of Non-Detect Data 28
Number of Missing Values	2	Percent Non-Detects 63.64%
Raw Statistics		
Minimum Detected	0.0451	Log-transformed Statistics Minimum Detected -3.099
Maximum Detected	204	Maximum Detected 5.318
Mean of Detected	13.12	Mean of Detected -1.253
SD of Detected	50.91	SD of Detected 2.065
Minimum Non-Detect	0.0502	Minimum Non-Detect -2.992
Maximum Non-Detect	1.14	Maximum Non-Detect 0.131
Note: Data have multiple DLs - Use of KM Method is recommended		
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Non-Detect 42
Observations < Largest ND are treated as NDs		Number treated as Detected 2
		Single DL Non-Detect Percentage 95.45%
UCL Statistics		
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only
Shapiro Wilk Test Statistic	0.28	Shapiro Wilk Test Statistic 0.739
5% Shapiro Wilk Critical Value	0.887	5% Shapiro Wilk Critical Value 0.887
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level
Assuming Normal Distribution		
DL/2 Substitution Method		Assuming Lognormal Distribution DL/2 Substitution Method
Mean	4.821	Mean -2.279
SD	30.73	SD 1.534
95% DL/2 (t) UCL	12.61	95% H-Stat (DL/2) UCL 0.674
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method
MLE method failed to converge properly		Mean in Log Scale -2.852
		SD in Log Scale 1.848
		Mean in Original Scale 4.794
		SD in Original Scale 30.73
		95% t UCL 12.58
		95% Percentile Bootstrap UCL 14.06
		95% BCA Bootstrap UCL 23.32
		95% H-UCL 0.845
Gamma Distribution Test with Detected Values Only		
k star (bias corrected)	0.199	Data Distribution Test with Detected Values Only Data do not follow a Discernable Distribution (0.05)
Theta Star	66.04	
nu star	6.359	
A-D Test Statistic 3.802 Nonparametric Statistics		
5% A-D Critical Value	0.881	Kaplan-Meier (KM) Method
K-S Test Statistic	0.881	Mean 4.81
5% K-S Critical Value	0.238	SD 30.38
Data not Gamma Distributed at 5% Significance Level		SE of Mean 4.73
Assuming Gamma Distribution		
Gamma ROS Statistics using Extrapolated Data		95% KM (t) UCL 12.76
Minimum	1.00E-06	95% KM (z) UCL 12.59
Maximum	204	95% KM (jackknife) UCL 12.6
Mean	4.779	95% KM (bootstrap t) UCL 1258
Median	1.00E-06	95% KM (BCA) UCL 14.1
SD	30.74	95% KM (Percentile Bootstrap) UCL 14.07
k star	0.0891	95% KM (Chebyshev) UCL 25.43
Theta star	53.65	97.5% KM (Chebyshev) UCL 34.35
Nu star	7.839	99% KM (Chebyshev) UCL 51.87
AppChi2	2.642	Potential UCLs to Use
95% Gamma Approximate UCL (Use when n >= 40)	14.18	99% KM (Chebyshev) UCL 51.87
95% Adjusted Gamma UCL (Use when n < 40)	14.75	
Note: DL/2 is not a recommended method.		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

**Table B-4 Summary of ProUCL Output - Sub-Surface Soil, Trichloroethene
BNSF Mission Wye, Livingston, Montana**

General Statistics		
Number of Valid Data	42	Number of Detected Data 10
Number of Distinct Detected Data	10	Number of Non-Detect Data 32
Number of Missing Values	4	Percent Non-Detects 76.19%
Raw Statistics		
Minimum Detected	0.0262	Log-transformed Statistics Minimum Detected -3.642
Maximum Detected	76.3	Maximum Detected 4.335
Mean of Detected	7.727	Mean of Detected -1.889
SD of Detected	24.09	SD of Detected 2.348
Minimum Non-Detect	0.0502	Minimum Non-Detect -2.992
Maximum Non-Detect	57.1	Maximum Non-Detect 4.045
Note: Data have multiple DLs - Use of KM Method is recommended		
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Non-Detect 41
Observations < Largest ND are treated as NDs		Number treated as Detected 1
		Single DL Non-Detect Percentage 97.62%
UCL Statistics		
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only
Shapiro Wilk Test Statistic	0.369	Shapiro Wilk Test Statistic 0.701
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value 0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level
Assuming Normal Distribution		
DL/2 Substitution Method		Assuming Lognormal Distribution DL/2 Substitution Method
Mean	2.557	Mean -2.626
SD	12.46	SD 1.573
95% DL/2 (t) UCL	5.792	95% H-Stat (DL/2) UCL 0.529
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method
MLE method failed to converge properly		Mean in Log Scale -3.154
		SD in Log Scale 1.391
		Mean in Original Scale 1.865
		SD in Original Scale 11.77
		95% t UCL 4.921
		95% Percentile Bootstrap UCL 5.493
		95% BCA Bootstrap UCL 7.327
		95% H-UCL 0.207
Gamma Distribution Test with Detected Values Only		
k star (bias corrected)	0.199	Data Distribution Test with Detected Values Only Data do not follow a Discernable Distribution (0.05)
Theta Star	38.87	
nu star	3.976	
A-D Test Statistic 2.376 Nonparametric Statistics		
5% A-D Critical Value	0.858	Kaplan-Meier (KM) Method
K-S Test Statistic	0.858	Mean 1.868
5% K-S Critical Value	0.295	SD 11.62
Data not Gamma Distributed at 5% Significance Level		SE of Mean 1.891
Assuming Gamma Distribution		
Gamma ROS Statistics using Extrapolated Data		95% KM (t) UCL 5.05
Minimum	1.00E-06	95% KM (z) UCL 4.978
Maximum	76.3	95% KM (jackknife) UCL 4.924
Mean	1.937	95% KM (bootstrap t) UCL 485.5
Median	1.00E-06	95% KM (BCA) UCL 5.516
SD	11.77	95% KM (Percentile Bootstrap) UCL 5.498
k star	0.0851	97.5% KM (Chebyshev) UCL 13.68
Theta star	22.76	99% KM (Chebyshev) UCL 20.68
Nu star	7.15	Potential UCLs to Use
AppChi2	2.253	99% KM (Chebyshev) UCL 20.68
95% Gamma Approximate UCL (Use when n >= 40)	6.147	
95% Adjusted Gamma UCL (Use when n < 40)	6.422	
Note: DL/2 is not a recommended method.		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

Appendix C

Chemical-Specific Intake Factors and Pathway- Specific Cleanup Levels

Table C-1 Calculation of Soil Intake Factors, Cleanup Levels and Risk Estimates for the Future Commercial/Industrial Worker

RECEPTOR: Commercial/Industrial Worker		
General Assumptions		
BW	Mean Body Weight (Kg):	80
AT	Averaging time (years):	78
	Carcinogenic	
	Noncarcinogenic	
	Days/year	365
	Years	25
ADAF	Age-dependent adjustment factor (mutagens)	1
Incidental Ingestion		
IR	Incidental Ingestion Rate (mg-soil/day):	100
FI	Fraction Ingested of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	187
ED	Exposure Duration (years):	25
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	2.05E-07
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	6.40E-07
Dermal Contact		
BSAE	Body Surface Area Exposed (cm ²):	3,470
AF	Adherence Factor (mg-soil/cm ² -event):	0.12
FC	Fraction Contacted of Daily Total (unitless):	1
EV	Event Frequency (events/day)	1
EF	Exposure Frequency (days/year):	187
ED	Exposure Duration (years):	25
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	8.55E-07
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	2.67E-06
Inhalation		
ET	Exposure Time (hours/day):	8
FI	Fraction Inhaled of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	187
ED	Exposure Duration (years):	25
	Intake Factor (carc, unitless)	5.47E-02
	Intake Factor (noncarc, unitless)	1.71E-01
Toxicity Value Source		
TV	Enter 1 for chronic and 2 for subchronic toxicity values	1

COPC	Cancer Slope Factor (mg/kg/day) ⁻¹	Cancer Slope Factor (mg/kg/day) ⁻¹	Unit Risk (µg/m ³) ¹	Reference Dose (mg/kg/day)	Reference Dose (mg/kg/day)	Reference Concentration (mg/m ³)	Volatile	MUTAGENIC	USEPA Mutagenic ADAF	ABS	RBA	EPA RSL Default PEF (kg/m ³)	Default Soil VF (kg/m ³)
	(Oral)	(Dermal)	(Inhalation)	(Oral)	(Dermal)	(Inhalation)	V = Volatile N = Not Volatile	M = Mutagenic N = Nonmutagenic	Unitless	(Dermal)	(Oral)	(kg/m ³)	(kg/m ³)
Tetrachloroethene	2.10E-03	2.10E-03	2.60E-07	6.00E-03	6.00E-03	4.00E-02	V	N	1	NA	1	NA	3.95E-04
Trichloroethene	4.60E-02	4.60E-02	4.10E-06	5.00E-04	5.00E-04	2.00E-03	V	M	1	NA	1	NA	4.20E-04

COPC	CHEMICAL-SPECIFIC NON CANCER INTAKES			CHEMICAL-SPECIFIC CANCER INTAKES			Cleanup Level: Noncancer Effects (HI=1)				Cleanup Level: Cancer Effects (TRL = 1x10 ⁻⁵)				Cleanup Level (mg/kg)
	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m ³)	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m ³)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	
Tetrachloroethene	6.40E-07	NA	6.75E-05	2.05E-07	NA	2.16E-05	9.37E+03	NA	5.93E+02	5.57E+02	2.32E+04	NA	1.78E+03	1.65E+03	5.57E+02
Trichloroethene	6.40E-07	NA	7.18E-05	2.05E-07	NA	2.30E-05	7.81E+02	NA	2.79E+01	2.69E+01	1.06E+03	NA	1.06E+02	9.64E+01	2.69E+01

COPC	Surface Soil EPC (mg/kg) (0-2 ft bgs)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	99.45	1.06E-02	NA	1.68E-01	1.78E-01	4.29E-08	NA	5.59E-07	6.02E-07
Trichloroethene	38.7	4.96E-02	NA	1.39E+00	1.44E+00	3.65E-07	NA	3.65E-06	4.01E-06

Hazard Index = 1.6

Cancer Risk Level= 4.6E-06

Incidental Ingestion:

$$IF_{carc} = (IR * FI * EF * ED * CF) / (BW * AT_{carc} * 365) * ADAF$$

$$IF_{noncarc} = (IR * FI * EF * ED * CF) / (BW * AT_{noncarc} * 365)$$

Dermal Contact:

$$IF_{carc} = (BSAE * AF * ABS_{der} * FC * EF * ED * EV * CF) / (BW * AT_{carc} * 365) * ADAF$$

$$IF_{noncarc} = (BSAE * AF * ABS_{der} * EF * ED * EV * CF) / (BW * AT_{noncarc} * 365)$$

Inhalation:

$$IF_{carc} = [PEF \text{ (non-volatiles) or VF (volatiles)}] * [(ET * FI * EF * ED) / (24 * AT_{carc} * 365)] * ADAF$$

$$IF_{noncarc} = [PEF \text{ (non-volatiles) or VF (volatiles)}] * [(ET * FI * EF * ED) / (24 * AT_{noncarc} * 365)]$$

Table C-2 Calculation of Soil Intake Factors, Cleanup Levels and Risk Estimates for the Future Construction Worker

RECEPTOR: Construction Worker		
General Assumptions		
BW	Mean Body Weight (Kg):	80
AT	Averaging time (years):	
	Carcinogenic	78
	Noncarcinogenic	
	Days/year	365
	Years	1
ADAF	Age-dependent adjustment factor (mutagens)	1
Incidental Ingestion		
IR	Incidental Ingestion Rate (mg-soil/day):	330
FI	Fraction Ingested of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	124
ED	Exposure Duration (years):	1
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	1.80E-08
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	1.40E-06
Dermal Contact		
BSAE	Body Surface Area Exposed (cm ²):	3,470
AF	Adherence Factor (mg-soil/cm ² -event):	0.21
FC	Fraction Contacted of Daily Total (unitless):	1
EV	Event Frequency (events/day)	1
EF	Exposure Frequency (days/year):	124
ED	Exposure Duration (years):	1
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	3.88E-08
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	3.03E-06
Inhalation		
ET	Exposure Time (hours/day):	8
FI	Fraction Inhaled of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	124
ED	Exposure Duration (years):	1
	Intake Factor (carc, unitless)	1.45E-03
	Intake Factor (noncarc, unitless)	1.13E-01
Toxicity Value Source		
TV	Enter 1 for chronic and 2 for subchronic toxicity values	1

COPC	Cancer Slope Factor (mg/kg/day) ⁻¹	Cancer Slope Factor (mg/kg/day) ⁻¹	Unit Risk (µg/m ³) ⁻¹	Reference Dose (mg/kg/day)	Reference Dose (mg/kg/day)	Reference Concentration (mg/m ³)	Volatile	MUTAGENIC	USEPA Mutagenic ADAF	ABS	RBA	EPA RSL Default PEF (kg/m ³)	Default Soil VF (kg/m ³)
	(Oral)	(Dermal)	(Inhalation)	(Oral)	(Dermal)	(Inhalation)	V = Volatile N = Not Volatile	M = Mutagenic N = Nonmutagenic	Unitless	(Dermal)	(Oral)	(kg/m ³)	(kg/m ³)
Tetrachloroethene	2.10E-03	2.10E-03	2.60E-07	6.00E-03	6.00E-03	4.00E-02	V	N	1	NA	1	NA	3.95E-04
Trichloroethene	4.60E-02	4.60E-02	4.10E-06	5.00E-04	5.00E-04	2.00E-03	V	M	1	NA	1	NA	4.20E-04

COPC	CHEMICAL-SPECIFIC NON CANCER INTAKES			CHEMICAL-SPECIFIC CANCER INTAKES			Cleanup Level: Noncancer Effects (HI=1)				Cleanup Level: Cancer Effects (TRL = 1x10 ⁻⁵)				Cleanup Level (mg/kg)
	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m ³)	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m ³)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	
Tetrachloroethene	1.40E-06	NA	4.48E-05	1.80E-08	NA	5.74E-07	4.28E+03	NA	8.94E+02	7.39E+02	2.65E+05	NA	6.70E+04	5.35E+04	7.39E+02
Trichloroethene	1.40E-06	NA	4.76E-05	1.80E-08	NA	6.10E-07	3.57E+02	NA	4.20E+01	3.76E+01	1.21E+04	NA	4.00E+03	3.01E+03	3.76E+01

COPC	Surface Soil EPC (mg/kg) (0-2 ft bgs)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	99.45	2.32E-02	NA	1.11E-01	1.35E-01	3.75E-09	NA	1.48E-08	1.86E-08
Trichloroethene	38.7	1.08E-01	NA	9.21E-01	1.03E+00	3.20E-08	NA	9.68E-08	1.29E-07

Hazard Index = 1.2 Cancer Risk Level= 1.5E-07

COPC	Subsurface Soil EPC (mg/kg) (0-10 ft bgs)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	51.87	1.21E-02	NA	5.80E-02	7.02E-02	1.96E-09	NA	7.74E-09	9.70E-09
Trichloroethene	20.68	5.80E-02	NA	4.92E-01	5.50E-01	1.71E-08	NA	5.17E-08	6.88E-08

Hazard Index = 0.6 Cancer Risk Level= 7.9E-08

Incidental Ingestion:
 $IF_{carc} = (IR \cdot FI \cdot EF \cdot ED \cdot CF) / (BW \cdot AT_{carc} \cdot 365) \cdot ADAF$
 $IF_{noncarc} = (IR \cdot FI \cdot EF \cdot ED \cdot CF) / (BW \cdot AT_{noncarc} \cdot 365)$

Dermal Contact:
 $IF_{carc} = (BSAE \cdot AF \cdot ABS_{der} \cdot FC \cdot EF \cdot ED \cdot EV \cdot CF) / (BW \cdot AT_{carc} \cdot 365) \cdot ADAF$
 $IF_{noncarc} = (BSAE \cdot AF \cdot ABS_{der} \cdot EF \cdot ED \cdot EV \cdot CF) / (BW \cdot AT_{noncarc} \cdot 365)$

Inhalation:
 $IF_{carc} = [PEF \text{ (non-volatiles) or VF (volatiles)}] \cdot [(ET \cdot FI \cdot EF \cdot ED) / (24 \cdot AT_{carc} \cdot 365) \cdot ADAF]$
 $IF_{noncarc} = [PEF \text{ (non-volatiles) or VF (volatiles)}] \cdot [(ET \cdot FI \cdot EF \cdot ED) / (24 \cdot AT_{noncarc} \cdot 365)]$

Table C-3 Calculation of Soil Intake Factors, Cleanup Levels, and Risk Estimates for the Future Visitor/Trespasser, Adolescent

RECEPTOR: Visitor/Trespasser (Adolescent)		
General Assumptions		
BW	Mean Body Weight (Kg):	45
AT	Averaging time (years):	78
	Carcinogenic	
	Noncarcinogenic	
	Days/year	
	Years	13
ADAF	Age-dependent adjustment factor (mutagens)	3
Incidental Ingestion		
IR	Incidental Ingestion Rate (mg-soil/day):	100
FI	Fraction Ingested of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	75
ED	Exposure Duration (years):	13
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	7.61E-08
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	4.57E-07
Dermal Contact		
BSAE	Body Surface Area Exposed (cm ²):	4,380
AF	Adherence Factor (mg-soil/cm ² -event):	0.04
FC	Fraction Contacted of Daily Total (unitless):	1
EV	Event Frequency (events/day)	1
EF	Exposure Frequency (days/year):	75
ED	Exposure Duration (years):	13
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	1.31E-07
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	7.84E-07
Inhalation		
ET	Exposure Time (hours/day):	2
FI	Fraction Inhaled of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	75
ED	Exposure Duration (years):	13
	Intake Factor (carc, unitless)	2.85E-03
	Intake Factor (noncarc, unitless)	1.71E-02
Toxicity Value Source		
TV	Enter 1 for chronic and 2 for subchronic toxicity values	1

COPC	Cancer Slope Factor (mg/kg/day) ⁻¹	Cancer Slope Factor (mg/kg/day) ⁻¹	Unit Risk (µg/m ³) ⁻¹	Reference Dose (mg/kg/day)	Reference Dose (mg/kg/day)	Reference Concentration (mg/m ³)	Volatile	MUTAGENIC	USEPA Mutagenic ADAF	ABS	RBA	EPA RSL Default PEF (kg/m ³)	Default Soil VF (kg/m ³)
	(Oral)	(Dermal)	(Inhalation)	(Oral)	(Dermal)	(Inhalation)	V = Volatile N = Not Volatile	M = Mutagenic N = Nonmutagenic	Unitless	(Dermal)	(Oral)	(kg/m ³)	(kg/m ³)
Tetrachloroethene	2.10E-03	2.10E-03	2.60E-07	6.00E-03	6.00E-03	4.00E-02	V	N	1	NA	1	NA	3.95E-04
Trichloroethene	4.60E-02	4.60E-02	4.10E-06	5.00E-04	5.00E-04	2.00E-03	V	M	3	NA	1	NA	4.20E-04

COPC	CHEMICAL-SPECIFIC NON CANCER INTAKES			CHEMICAL-SPECIFIC CANCER INTAKES			Cleanup Level: Noncancer Effects (HI=1)			Cleanup Level: Cancer Effects (TRL = 1x10 ⁻⁵)				Cleanup Level (mg/kg)	
	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m ³)	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW)	Inhalation Soil Intake (kg/m ³)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)		Combined (mg/kg)
Tetrachloroethene	4.57E-07	NA	6.77E-06	7.61E-08	NA	1.13E-06	1.31E+04	NA	5.91E+03	4.08E+03	6.26E+04	NA	3.41E+04	2.21E+04	4.08E+03
Trichloroethene	4.57E-07	NA	7.19E-06	2.28E-07	NA	3.60E-06	1.10E+03	NA	2.78E+02	2.22E+02	9.52E+02	NA	6.78E+02	3.96E+02	2.22E+02

COPC	Surface Soil EPC (mg/kg) (0-2 ft bgs)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	99.45	7.57E-03	NA	1.68E-02	2.44E-02	1.59E-08	NA	2.92E-08	4.51E-08
Trichloroethene	38.7	3.53E-02	NA	1.39E-01	1.75E-01	4.06E-07	NA	5.71E-07	9.77E-07

Hazard Index = 0.2

Cancer Risk Level= 1.0E-06

Incidental Ingestion:

$$IF_{carc} = (IR * FI * EF * ED * CF) / (BW * AT_{carc} * 365) * ADAF$$

$$IF_{noncarc} = (IR * FI * EF * ED * CF) / (BW * AT_{noncarc} * 365)$$

Dermal Contact:

$$IF_{carc} = (BSAE * AF * ABS_{der} * FC * EF * ED * EV * CF) / (BW * AT_{carc} * 365) * ADAF$$

$$IF_{noncarc} = (BSAE * AF * ABS_{der} * EF * ED * EV * CF) / (BW * AT_{noncarc} * 365)$$

Inhalation:

$$IF_{carc} = [PEF (non-volatiles) or VF (volatiles)] * [(ET * FI * EF * ED) / (24 * AT_{carc} * 365)] * ADAF$$

$$IF_{noncarc} = [PEF (non-volatiles) or VF (volatiles)] * [(ET * FI * EF * ED) / (24 * AT_{noncarc} * 365)]$$

Table C-4 Calculation of Soil Intake Factors, Cleanup Levels, and Risk Estimates for the Future Adult Resident

RECEPTOR: Adult Resident		
General Assumptions		
BW	Mean Body Weight (Kg):	80
AT	Averaging time (years):	
	Carcinogenic	78
	Noncarcinogenic	
	Days/year	365
	Years	26
ADAF	Age-dependent adjustment factor (mutagens)	1
Incidental Ingestion		
IR	Incidental Ingestion Rate (mg-soil/day):	100
FI	Fraction Ingested of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	270
ED	Exposure Duration (years):	26
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	3.08E-07
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	9.25E-07
Dermal Contact		
BSAE	Body Surface Area Exposed (cm²):	6,032
AF	Adherence Factor (mg-soil/cm²-event):	0.07
FC	Fraction Contacted of Daily Total (unitless):	1
EV	Event Frequency (events/day)	1
EF	Exposure Frequency (days/year):	270
ED	Exposure Duration (years):	26
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	1.30E-06
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	3.90E-06
Inhalation		
ET	Exposure Time (hours/day):	24
FI	Fraction Inhaled of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	270
ED	Exposure Duration (years):	26
	Intake Factor (carc, unitless)	2.47E-01
	Intake Factor (noncarc, unitless)	7.40E-01
Toxicity Value Source		
TV	Enter 1 for chronic and 2 for subchronic toxicity values	1

COPC	Cancer Slope Factor (mg/kg/day) ⁻¹	Cancer Slope Factor (mg/kg/day) ⁻¹	Unit Risk (µg/m³) ⁻¹	Reference Dose (mg/kg/day)	Reference Dose (mg/kg/day)	Reference Concentration (mg/m³)	Volatile	MUTAGENIC	USEPA Mutagenic ADAF	ABS	RBA	EPA RSL Default PEF (kg/m³)	Default Soil VF (kg/m³)
	(Oral)	(Dermal)	(Inhalation)	(Oral)	(Dermal)	(Inhalation)	V = Volatile N = Not Volatile	M = Mutagenic N = Nonmutagenic	Unitless	(Dermal)	(Oral)	(kg/m³)	(kg/m³)
Tetrachloroethene	2.10E-03	2.10E-03	2.60E-07	6.00E-03	6.00E-03	4.00E-02	V	N	1	NA	1	NA	3.95E-04
Trichloroethene	4.60E-02	4.60E-02	4.10E-06	5.00E-04	5.00E-04	2.00E-03	V	M	1	NA	1	NA	4.20E-04

COPC	CHEMICAL-SPECIFIC NON CANCER INTAKES			CHEMICAL-SPECIFIC CANCER INTAKES			Cleanup Level: Noncancer Effects (HI=1)			Cleanup Level: Cancer Effects (TRL = 1x10 ⁻⁵)				Cleanup Level (mg/kg)	
	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m³)	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m³)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)		Combined (mg/kg)
Tetrachloroethene	9.25E-07	NA	2.92E-04	3.08E-07	NA	9.75E-05	6.49E+03	NA	1.37E+02	1.34E+02	1.54E+04	NA	3.95E+02	3.85E+02	1.34E+02
Trichloroethene	9.25E-07	NA	3.11E-04	3.08E-07	NA	1.04E-04	5.41E+02	NA	6.43E+00	6.36E+00	7.05E+02	NA	2.35E+01	2.28E+01	6.36E+00

COPC	Surface Soil EPC (mg/kg) (0-2 ft bgs)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	99.45	1.53E-02	NA	7.27E-01	7.42E-01	6.44E-08	NA	2.52E-06	2.58E-06
Trichloroethene	38.7	7.16E-02	NA	6.01E+00	6.09E+00	5.49E-07	NA	1.64E-05	1.70E-05

Hazard Index = 6.8

Cancer Risk Level= 2.0E-05

Incidental Ingestion:

$$IF_{carc} = (IR \cdot FI \cdot EF \cdot ED \cdot CF) / (BW \cdot AT_{carc} \cdot 365) \cdot ADAF$$

$$IF_{noncarc} = (IR \cdot FI \cdot EF \cdot ED \cdot CF) / (BW \cdot AT_{noncarc} \cdot 365)$$

Dermal Contact:

$$IF_{carc} = (BSAE \cdot AF \cdot ABS_{der} \cdot FC \cdot EF \cdot ED \cdot EV \cdot CF) / (BW \cdot AT_{carc} \cdot 365) \cdot ADAF$$

$$IF_{noncarc} = (BSAE \cdot AF \cdot ABS_{der} \cdot EF \cdot ED \cdot EV \cdot CF) / (BW \cdot AT_{noncarc} \cdot 365)$$

Inhalation:

$$IF_{carc} = [PEF \text{ (non-volatiles) or VF (volatiles)}] \cdot [(ET \cdot FI \cdot EF \cdot ED) / (24 \cdot AT_{carc} \cdot 365)] \cdot ADAF$$

$$IF_{noncarc} = [PEF \text{ (non-volatiles) or VF (volatiles)}] \cdot [(ET \cdot FI \cdot EF \cdot ED) / (24 \cdot AT_{noncarc} \cdot 365)]$$

Table C-5 Calculation of Soil Intake Factors, Cleanup Levels, and Risk Estimates for the Future Child Resident

RECEPTOR: Child Resident

General Assumptions		
BW	Mean Body Weight (Kg):	15
AT	Averaging time (years):	78
	Carcinogenic	
	Noncarcinogenic	
	Days/year	
	Years	6
ADAF	Age-dependent adjustment factor (mutagens)	10
Incidental Ingestion		
IR	Incidental Ingestion Rate (mg-soil/day):	200
FI	Fraction Ingested of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	270
ED	Exposure Duration (years):	6
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	7.59E-07
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	9.86E-06
Dermal Contact		
BSAE	Body Surface Area Exposed (cm²):	2,690
AF	Adherence Factor (mg-soil/cm²-event):	0.20
FC	Fraction Contacted of Daily Total (unitless):	1
EV	Event Frequency (events/day)	1
EF	Exposure Frequency (days/year):	270
ED	Exposure Duration (years):	6
CF	Conversion Factor (Kg-soil/mg-soil):	1.00E-06
	Intake Factor (carc, Kg-soil/Kg-BW-day)	2.04E-06
	Intake Factor (noncarc, Kg-soil/Kg-BW-day)	2.65E-05
Inhalation		
ET	Exposure Time (hours/day):	24
FI	Fraction Inhaled of Daily Total (unitless):	1
EF	Exposure Frequency (days/year):	270
ED	Exposure Duration (years):	6
	Intake Factor (carc, unitless)	5.69E-02
	Intake Factor (noncarc, unitless)	7.40E-01
Toxicity Value Source		
TV	Enter 1 for chronic and 2 for subchronic toxicity values	1

COPC	Cancer Slope Factor (mg/kg/day) ⁻¹	Cancer Slope Factor (mg/kg/day) ⁻¹	Unit Risk (µg/m³) ⁻¹	Reference Dose (mg/kg/day)	Reference Dose (mg/kg/day)	Reference Concentration (mg/m³)	Volatile	MUTAGENIC	USEPA Mutagenic ADAF	ABS	RBA	EPA RSL Default PEF (kg/m³)	Default Soil VF (kg/m³)
	(Oral)	(Dermal)	(Inhalation)	(Oral)	(Dermal)	(Inhalation)	V = Volatile N = Not Volatile	M = Mutagenic N = Nonmutagenic	Unitless	(Dermal)	(Oral)	(kg/m³)	(kg/m³)
Tetrachloroethene	2.10E-03	2.10E-03	2.60E-07	6.00E-03	6.00E-03	4.00E-02	V	N	1	NA	1	NA	3.95E-04
Trichloroethene	4.60E-02	4.60E-02	4.10E-06	5.00E-04	5.00E-04	2.00E-03	V	M	10	NA	1	NA	4.20E-04

COPC	CHEMICAL-SPECIFIC NON CANCER INTAKES			CHEMICAL-SPECIFIC CANCER INTAKES			Cleanup Level: Noncancer Effects (HI=1)				Cleanup Level: Cancer Effects (TRL = 1x10 ⁻⁵)				Cleanup Level (mg/kg)
	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW-day)	Inhalation Soil Intake (kg/m³)	Oral Soil Intake (Kg-soil/Kg-BW-day)	Dermal Soil Intake (Kg-soil/Kg-BW)	Inhalation Soil Intake (kg/m³)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	Ingestion (mg/kg)	Dermal (mg/kg)	Inhalation (mg/kg)	Combined (mg/kg)	
Tetrachloroethene	9.86E-06	NA	2.92E-04	7.59E-07	NA	2.25E-05	6.08E+02	NA	1.37E+02	1.12E+02	6.28E+03	NA	1.71E+03	1.34E+03	1.12E+02
Trichloroethene	9.86E-06	NA	3.11E-04	7.59E-06	NA	2.39E-04	5.07E+01	NA	6.43E+00	5.71E+00	2.87E+01	NA	1.02E+01	7.52E+00	5.71E+00

COPC	Surface Soil EPC (mg/kg) (0-2 ft bgs)	Risk: Noncancer Effects				Risk: Cancer Effects			
		Ingestion	Dermal	Inhalation	Combined	Ingestion	Dermal	Inhalation	Combined
Tetrachloroethene	99.45	1.63E-01	NA	7.27E-01	8.90E-01	1.58E-07	NA	5.82E-07	7.40E-07
Trichloroethene	38.7	7.63E-01	NA	6.01E+00	6.78E+00	1.35E-05	NA	3.79E-05	5.14E-05

Hazard Index = 7.7

Cancer Risk Level= 5.2E-05

Incidental Ingestion:

$$IF_{carc} = (IR * FI * EF * ED * CF) / (BW * AT_{carc} * 365) * ADAF$$

$$IF_{noncarc} = (IR * FI * EF * ED * CF) / (BW * AT_{noncarc} * 365)$$

Dermal Contact:

$$IF_{carc} = (BSAE * AF * ABS_{der} * FC * EF * ED * EV * CF) / (BW * AT_{carc} * 365) * ADAF$$

$$IF_{noncarc} = (BSAE * AF * ABS_{der} * EF * ED * EV * CF) / (BW * AT_{noncarc} * 365)$$

Inhalation:

$$IF_{carc} = [PEF \text{ (non-volatiles) or } VF \text{ (volatiles)}] * [(ET * FI * EF * ED) / (24 * AT_{carc} * 365)] * ADAF$$

$$IF_{noncarc} = [PEF \text{ (non-volatiles) or } VF \text{ (volatiles)}] * [(ET * FI * EF * ED) / (24 * AT_{noncarc} * 365)]$$

Appendix D

Calculation of Site-Specific Soil Cleanup Levels Considered Protective of Groundwater via Leaching

Table D-1 Equation Inputs for Calculation of the Site-Specific Dilution Attenuation Factor and Soil Screening Level Considered Protective of Groundwater via Leaching (i.e., the Soil to Groundwater Migration Pathway)

Site-Specific Variable	Value	Basis		
DAF (dilution attenuation factor) unitless	56.484515	calculated		
d_a (aquifer thickness) m - site-specific	3	site-specific		
d (mixing zone depth) m - site-specific	0.10777179	calculated		
L (source length parallel to ground water flow) m	1	site-specific		
i (hydraulic gradient) m/m	0.003	site-specific		
K (aquifer hydraulic conductivity) m/yr	30890	site-specific		
I (Infiltration Rate) m/yr	0.18	EPA Default		
Chemical-Specific Values	USEPA Default SSL (mg/kg)	Basis	Site-specific DAF	Site-specific SSL (mg/kg)
Iron	350	Risk-based	56.48	19,768
Manganese	28	Risk-based	56.48	1,581
Tetrachloroethene	2.3E-03	MCL-based	56.48	0.13
Trichloroethene	1.8E-03	MCL-based	56.48	0.10

Notes:

MCL = maximum contaminant level

mg/kg = milligrams per kilogram

DAF = dilution attenuation factor

SSL = soil screening level considered protective of groundwater via leaching; applied as the cleanup level

Risk-based SSLs are based on a noncancer hazard quotient of 1.0

The site-specific DAF was calculated using USEPA's online RSL calculator available at <http://epa-prgs.onl.gov>

Site-specific SSL = Default SSL x DAF

References:

1) USEPA 2014. Regional Screening Level Table. May 2014. Available online at: <http://www.epa.gov/region9/superfund/prg/>

2) USEPA 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. Publication 9355.4-17A. May 1996.

Equation Used to Calculate the Dilution Attenuation Factor
 Soil to Groundwater Equations
 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/equations.htm)

- Dilution Factor

$$\text{Dilution Attenuation Factor (DAF)} = 1 + \frac{K \left(\frac{\text{m}}{\text{year}} \right) \times i \left(\frac{\text{m}}{\text{m}} \right) \times d \text{ (m)}}{I \left(\frac{0.10 \text{ m}}{\text{year}} \right) \times L \text{ (m)}}$$

where:

$$d \text{ (m)} = \left(0.0112 \times L^2 \text{ (m)} \right)^{0.5} + d_a \times \left[1 - \exp \left(\frac{-L \text{ (m)} \times I \left(\frac{\text{m}}{\text{year}} \right)}{K \left(\frac{\text{m}}{\text{year}} \right) \times i \left(\frac{\text{m}}{\text{m}} \right) \times d_a \text{ (m)}} \right) \right]$$